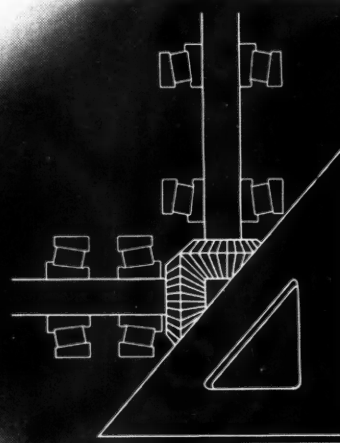


AUTOMOTIVE *and Aviation* INDUSTRIES

NOVEMBER 15, 1943

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*Where power makes a right angle turn
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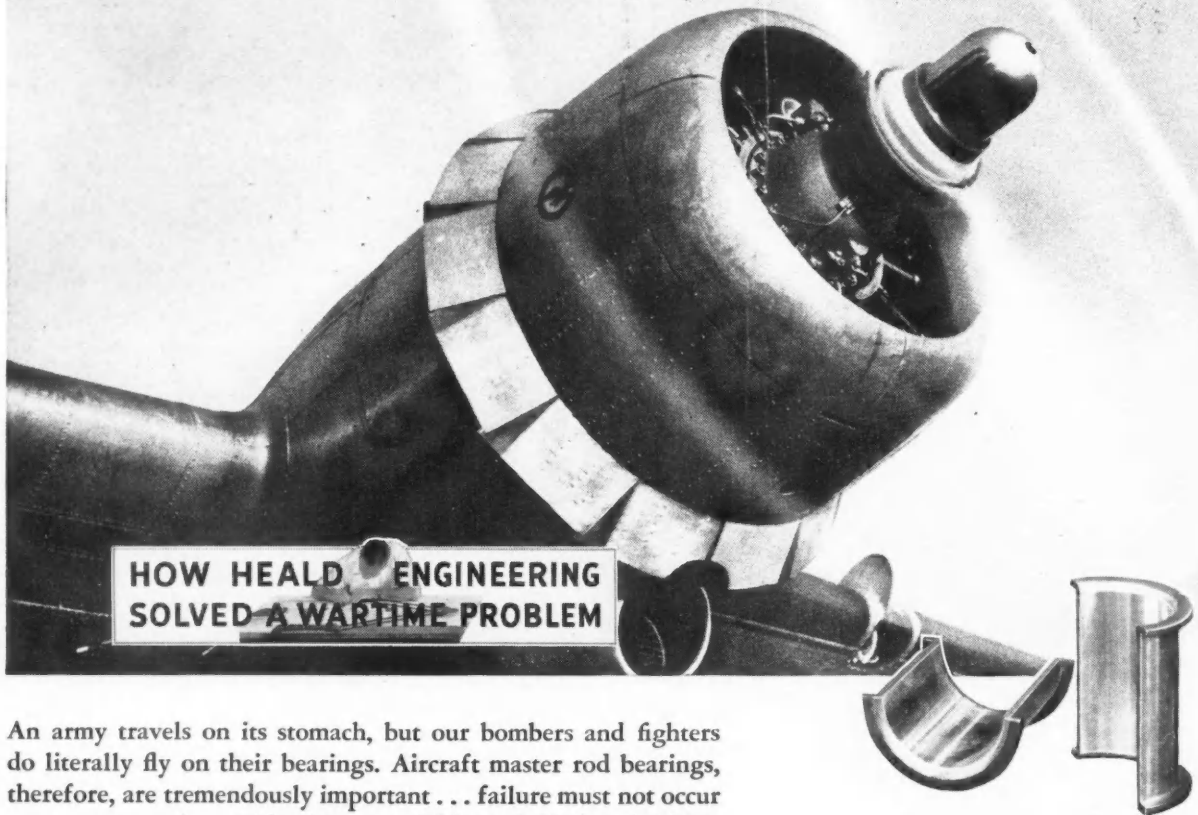
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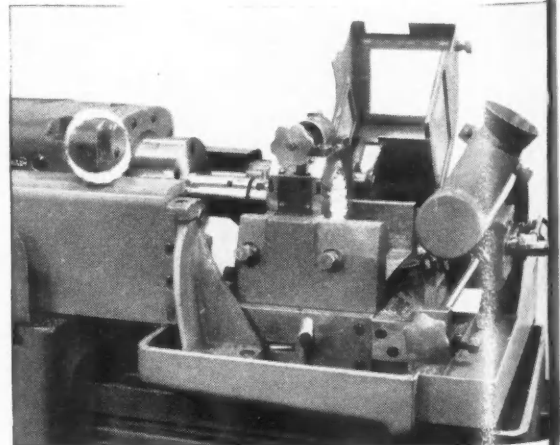
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AUTOMOTIVE and Aviation INDUSTRIES

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November 15, 1943

Number 10

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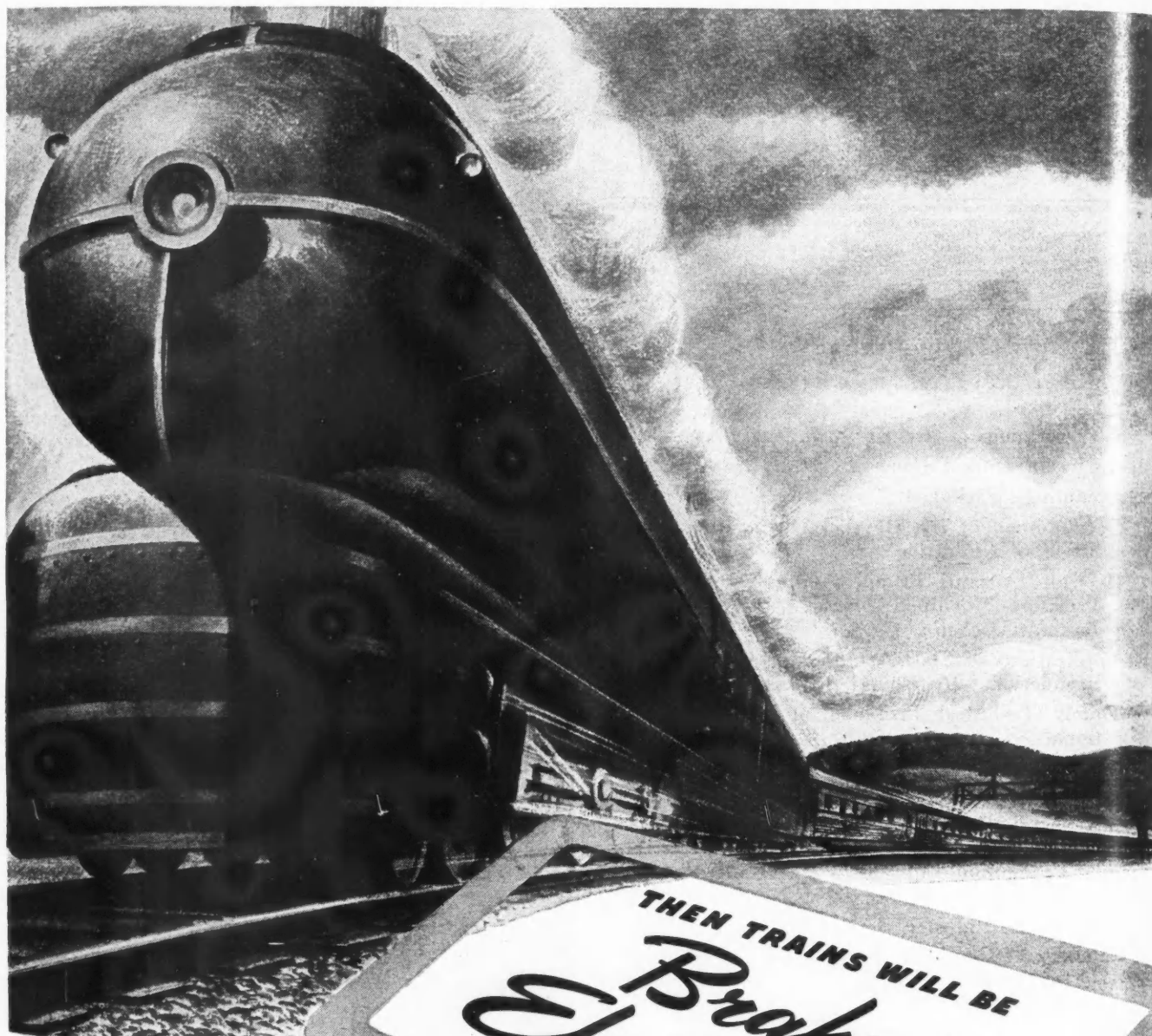
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IN THIS ISSUE

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Volume 89 November 15, 1943 No. 10

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For years steel users have been using a variety of methods in specifying steel needed for particular purposes. Here is a treatise on how to get what you want, with a lot of valuable information right from the fountain head.

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In order to meet manufacturing requirements, the tanks of our fighting forces have been powered by seven different types of engines. This article is a description of the different types and is liberally illustrated.

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This twin engined plane is used by our enemy both as a bomber and as a transport plane. It is a most formidable weapon and is of particular interest. We are fortunate in being able to present with this article a number of pictures of the equipment.

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Flash welding in recent months has had a surge of popularity in the fabrication of airplanes. The how's and the why's and all the other details are told in this treatise, with experiences of one of the world's largest makers of planes.

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In the opening paragraph the author says, "Today the industry is making great forward strides with the application of new techniques, especially in X-ray examination of airplane components." That should be enough to suggest that it is well worth reading.

**AUTOMOTIVE
INDUSTRIES**

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An End to Apology!

By Julian Chase

THERE may have been a brief period when, in their public utterances, it was expedient or politically wise for exponents of American capitalism to be restrained in their praise of its accomplishments and admissively apologetic with respect to the errors and shortcomings charged against it and against them, by avowed enemies and by those of little faith and even less knowledge. Some of our outstanding industrial leaders undoubtedly thought that there was such a time and spoke and wrote accordingly. In the popular mind, did they help their cause more than they hurt it? That is a question. But, if there ever was such a time it certainly is not now.

As a matter of cold, hard fact, American capitalism, which we sometimes choose to call the American System of Free Enterprise, or the Economy of Individual Initiative, needs no apologists. It never did. And this can be said, too, and with equal emphasis, of the record of the men—the industrialists, the business men big and little—who have helped most to make it work.

By whom can that record be matched or even approached in terms of living standards and widespread benefits for mankind? Certainly not by the statesmen of recent generations who have, without subsequent apologies, made world shattering mistakes. Certainly not by the politicians or by the chair-warming theorists, pinkish or otherwise.

The record is plain. It is impressive. Under the American system, through individual initiative stimulated by the hope of rightful reward, industrialists—business men—built America and all that is in it. They developed its fabulous wealth. They created well paid jobs for increasing millions. They gave us life on a plane of luxury that has nowhere else at any time been equalled. They were prime factors in saving us from the statemen's and the politicians' colossal error of unpreparedness. Why should they apologize either for their own relatively inconsequential errors or for the system under which their wonders have been worked. For the good of America, they should not.

Let's put an end to pussyfoot apologetics. This, as never before, is a time for forceful, two-fisted advocacy and vigorous support of the Economy of Individual Initiative, of the incomparable American industrial system and the men who have shaped and led it.



Ryerson now interprets modified Jominy Test results in terms of quenched and drawn physical properties for 1, 2, 3, and 4-inch round alloy steel bars.

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New Data on Alloy Physicals

Ryerson furnishes hardenability interpretations with each alloy steel shipment

The new Ryerson Alloy Steel Report sheet is furnished with each shipment of alloy steels from stock. This report includes: a positive identification for the steel you receive . . . its chemical analysis as reported by the mill . . . the recommended working temperatures of the steel . . . a chart of its hardenability response with interpretations of the physical properties *after* heat treatment and the effect of mass on the physicals of 1, 2, 3, and 4-inch bars.

All this information makes it easier for you to specify your alloy steel requirements in

terms of *what the steel will do* . . . rather than on analysis alone. It further guides you in the proper heat treatment of your steel to obtain the best results.

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The Tire Crisis

By James R. Custer

THE present civilian tire crisis, which threatens to seriously disrupt the Nation's motor transportation system, including both commercial vehicle operation and essential passenger car use, has been precipitated by the shortage of plants, equipment and manpower to manufacture synthetic rubber tires in sufficient quantities. For almost two years the tire supply situation has been growing worse and now has reached the proportions of an acute shortage in nearly every section of the country with pent-up needs growing daily. In fact, inventory tire stocks (see charts on this page) already have become so low that it is regarded as dangerous to draw further from them, which means that new civilian tires will be only available next year as the factories build them. The output of synthetic rubber tires will continue upwards, but indications are that the rate of increase will not provide nearly enough to meet the 1944 civilian tire requirements.

A survey of the national tire situation discloses that for this year the total supply of passenger car tires, including emergency (subnormal) tires, amounts to about 23 millions, or two million tires short of the needs set by the Office of Price Administration ration-

ing authorities. It is estimated that the 1944 shortage will be much greater with a 25 per cent deficit of 10 million tires (see Summary of Automobile Tire Situation table on page 166). The 1944 truck tire outlook appears even worse—a shortage of 2.7 million tires amounting to a deficit of 36 per cent.

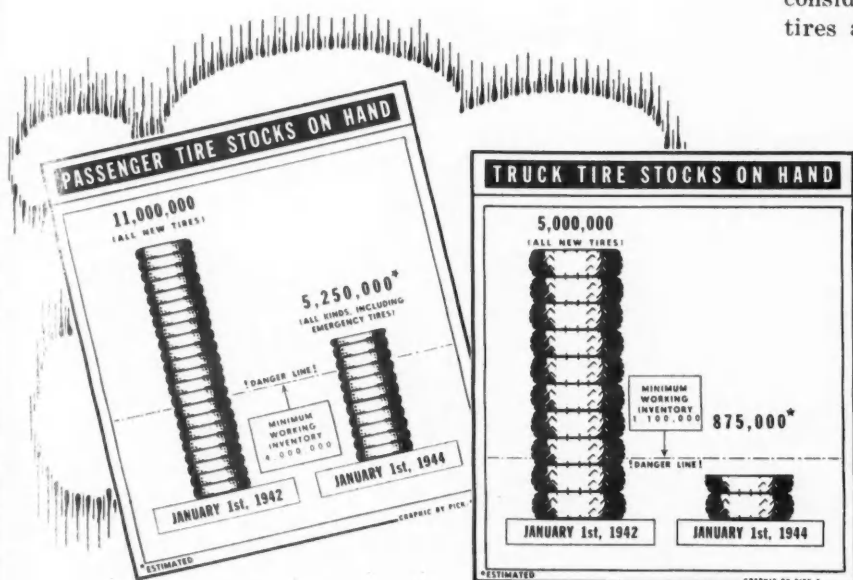
A joint undertaking of the entire tire industry reflects the seriousness of the emergency. Under the direction of the Tire Division of the Rubber Manufacturers Association a nation-wide tire conservation campaign has been launched with 38 companies, 100 per cent of the tire industry, participating in it in an effort to prevent a widespread lay-up of cars and trucks. They are urging owners to take all possible preventive care to prolong the life of their tires and to have them recapped just as soon as they are worn smooth. Rubber Director Bradley Dewey in Progress Report No. 4 issued Nov. 10 discusses the tire shortage, especially in the supply of truck tires, and points out that National surveys show that tire treads on large numbers of motor vehicles are seriously worn.

OPA has instituted a precautionary measure by cutting November new tire rationing quotas considerably below the October allotment. New tires available for passenger cars are reduced

14 per cent to 553,688 and new truck tires 30 per cent less to 290,245. December's new tire quotas are scheduled to be held to the November levels. Monthly quotas are established by OPA for rationing on the basis of allotments assigned by the Office of the Rubber Director, the branch of the War Production Board responsible for the production of rubber and rubber products.

Anticipating a greater demand for used tires due to the reduction of new tire quotas, OPA found it possible to in-

(Turn to page 164, please)



FOR many years, steel users have been endeavoring to specify alloy steels on ever narrowing analysis ranges. Steel producers have constantly improved their manufacturing methods in an effort to meet this demand. In all probability, however, it would be very difficult to operate, on a commercially sound basis, and produce composition ranges more narrow than those in use today.

The performance of steel is governed in the main by its analysis. Performance may be defined as the behavior of steel in relation to machinability, response to heat treatment, required physicals, and other characteristics. Uniformity of performance is a desirable characteristic of any industrially used product. Therefore, the specifying of close analysis control has as its objective the procurement of steel which will be uniform in performance.

The control of steel performance by the analysis method is difficult, because all elements entering into the composition of steel have a plus or minus effect on its performance and therefore, such control involves the accurate manipulation of all these elements by the steel maker. In many standard steel analysis specifications, some elements are controlled by top limits, such as phosphorus and sulphur, and other elements are controlled by both top and bottom limits, such as carbon, manganese, silicon, nickel, chrome, molybdenum, etc. This means that the steel maker's first consideration is to produce steel which is within the chemical limits. Under such a condition he cannot be also restricted by a performance specification because the purchaser of the steel has taken upon himself the responsibility of performance, provided that the steelmaker meets the chemical analysis which he has demanded. If the steel producer knew the performance requirements of an application and was told the type of steel preferred, then he could work to the performance requirements of the customer, provided that he was given reasonably wide leeway in chemical analysis.

The scarcity of alloying elements caused by war conditions rendered necessary the development of entirely new low alloy content steels to take the place of steels previously used which contained high percentages of alloys. There was not sufficient time to check these steels by commercial use and therefore a method had to be adopted to evaluate their performance ability by a test that could be quickly and accurately made. This problem was solved by the use of the Jominy End Quench Hardenability Test, which has been applied in a sufficient number of cases to indicate its reliability in predicting how the steel would perform in standard or commercial applications.

Steel Hardenability Factors

The work done along these lines in connection with the National Emergency (NE) Steels has started the

idea of specifying steels on a performance basis rather than on a chemical analysis basis, and the purpose of this article is to cover some of the high points of this subject and to suggest how it might be applied to actual commercial practice. This method of specification of steel is making considerable headway and probably will be an important factor in the selection and purchase of steel in the future. Most alloy steels are subjected to some form of heat treatment before being put to use. Therefore, it is necessary that such steels be purchased with as accurate knowledge as possible of their ability to respond to heat treatment, or, as it is more frequently called, their "hardenability."

The hardenability of steel is principally controlled by its analysis. The surface hardness as developed by quenching is, in the main, controlled by the carbon content and the depth of penetration of hardness is largely controlled by the alloy content of the steel as well as the inherent grain size. There are other factors, difficult to identify, which have an effect on the hardenability of steel. This is evidenced by the fact that two steels of almost identical composition and grain size will have different hardenabilities. This individuality of a specific heat of steel, which enables it to harden to a greater extent than other heats of

How Do You Specify

similar or almost identical composition, is very hard to define, and impossible to specify in terms of analysis or any other controllable factor.

Usually steel is purchased for certain requirements, and certain degrees of hardenability are necessary to make it suitable for the application for which it is purchased. It would seem, therefore, that the logical way to specify the steel would be on the basis of its hardenability rather than by the indirect route of specifying analysis and grain size.

There is nothing new about this method of buying steel to a hardness specification. In the early days of steel and before chemical analysis was understood or used, steel was actually sold on a hardenability basis. The old methods of manufacture were imperfect and not subject to close control. It was impossible for the steelmaker to predict just how a certain batch of steel would harden before he had actually tested it. For this reason, steel was sold on the basis of hardenability after being tested. Chemical composition, grain size, and the other factors which govern hardenability were not understood, and the final test, therefore, controlled the classification of the product and in all probability, the price.

If the analysis and grain size of a certain heat of steel is submitted to a well-posted metallurgist, he can, by calling on his past experience, make a very good guess at the physical properties which will be secured from the steel by a certain type of heat treatment. If the physical requirements of the job are not too exacting, such a metallurgical prognostication may be satisfactory. If, on the other hand, rather accurate heat treatment is necessary, then the only method of determining the suitability of the steel and heat treatment will be by actual test, which involves considerable time and expense. It is possible that steel bought to a certain chemical specification might prove unsatisfactory for a particular application after the tests had been made.

Suggested Procedure for Specifying Alloy Steels

A more logical method of specifying alloy steels would be to first select a certain *type* of steel; and then instead of specifying the exact chemical composition, simply require that the steel have a *certain specified degree of hardenability*; which is, of course, also a measure of strength. This method of procurement would not necessarily mean any change in the type of alloy steel being used. Thus: If a manufacturer had been using AISI A-3140 steel in the past, he would

continue to specify "AISI Type A-3100" but would specify the hardenability instead of a full analysis range.

Prior to the advent of the Jominy End Quench Hardenability method, hardenability tests took considerable time and were expensive and most manufacturing plants lacked the necessary equipment to conduct them properly. The Jominy Test is simple, easy to conduct and remarkably accurate in its results. A sample of the steel being tested is machined to approximately 1 in. in diameter and 4 in. long. The sample is heated to the proper quenching temperature for that steel. It is then placed in a fixture and quenched with a jet of water that *only comes in contact with the end of the sample*.

The result of this quenching method is that the sample is cooled very rapidly at one end and very slowly at the other end. In between these two extremes all practical rates of quenching are applied to the sample. The rate of quenching is the major factor governing the physical properties secured from heat treatment, and by making hardness test along the length of the quenched Jominy sample it is possible to determine how the steel behaves at different quenching rates ranging from about 600 deg. per sec-

(Turn to page 78, please)

Steel.... By Analysis or Performance?

**By
Greswold
Van Dyke**

Manager Special Steels
Dept., Joseph T. Ryerson & Son, Inc.

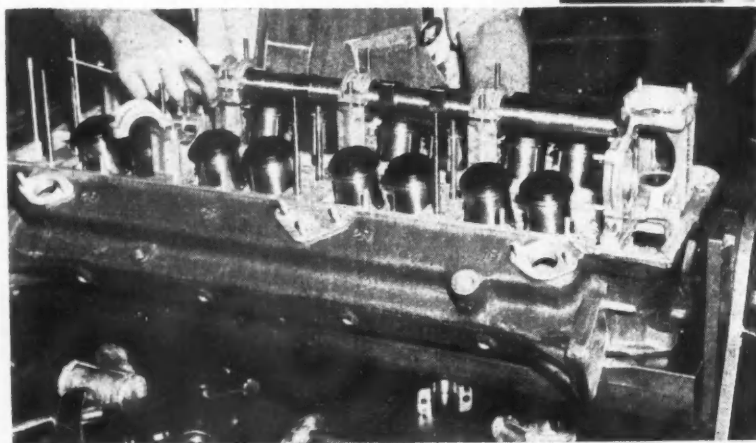


SO THAT powerplants could be supplied in adequate numbers for American tanks in volume production during the past two years, automotive companies have been manufacturing engines of seven different designs—three for the light tanks and four for the medium tanks. Light tanks of the M3 series are equipped with radial air-cooled aviation engines, one of a Continental 7-cylinder gasoline engine and the other a Guiberson 9-cylinder Diesel. The M5 light tank is powered by two Cadillac V-8 engines, incorporating Hydra-Matic transmissions, which are mounted side by side in combination with a transfer case. They are substantially the same as the units built for Cadillac cars.

The medium tank powerplants (M3 General Grant and M4 General Sherman tanks) consist of a Continental-built 9-cylinder radial air-cooled engine developed from the Wright Whirlwind, a General Motors two-stroke Diesel, a Ford V-8 gasoline engine, and a Chrysler multibank engine. Photographs are reproduced here showing details of the various powerplants.

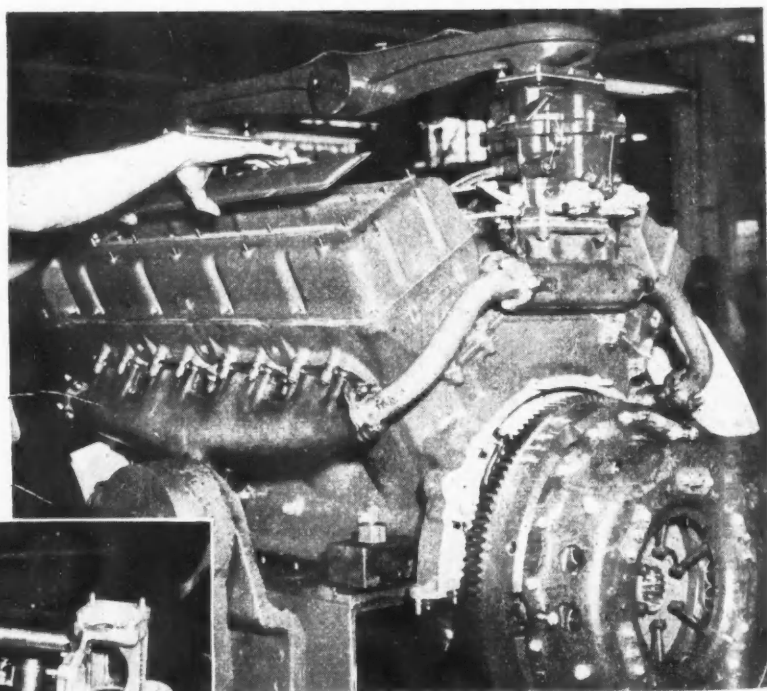
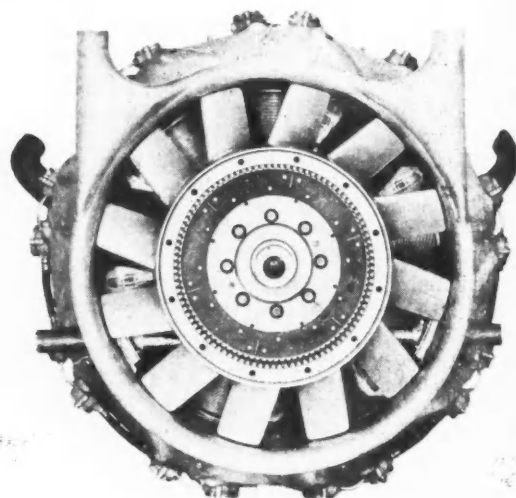
The Ford tank engine is a liquid-cooled, V-type, 8-cylinder engine weighing approximately 1500 lb. and developing 500 hp at 2600 rpm. Basic specifications for its design were taken from a 12-cylinder aircraft engine built by Ford as an independent project in 1940 and 1941, and its mass production has been accomplished with a minimum of change in available machinery.

(Below) Assembling one of the cylinder heads of a Ford V-8 tank engine. Each head has two camshafts.



American

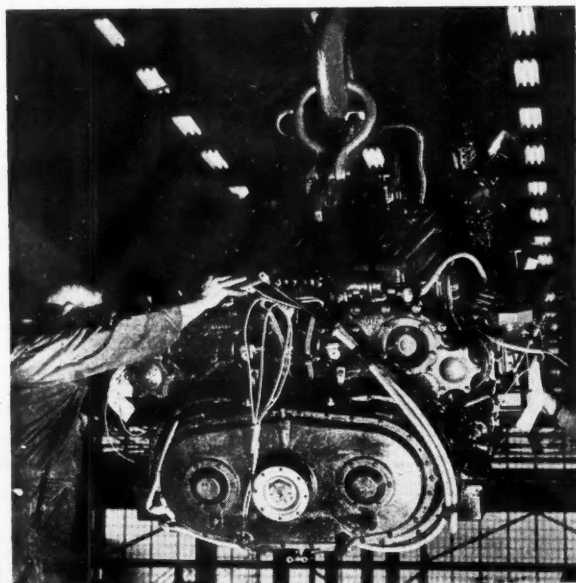
This Guiberson radial Diesel engine was developed to power light tanks. With cooling fan installed its normal rating is 210 bhp at 2200 rpm.



(Above) One of the two carburetors, the arrangement for passing exhaust gases through the intake heater box, and the clutch are shown in this view of the Ford tank engine. An inspection plate is being attached on the head during the final stage of assembly.

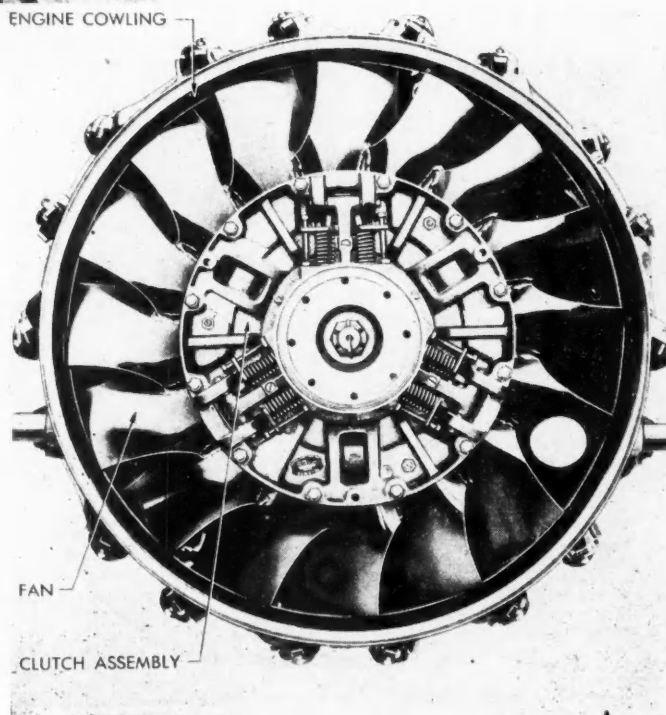
n Tank Engines

General Motors Diesel twin-engined powerplants are shown here being installed in tanks. This powerplant was developed by combining two six-cylinder engines.



(Below) Front view of the Continental-built medium tank engine. The De-Bothezat fan for cooling this 9-cyl. radial engine has die-formed steel blades. The clutch is of Lipe-Rollway make.

ENGINE COWLING



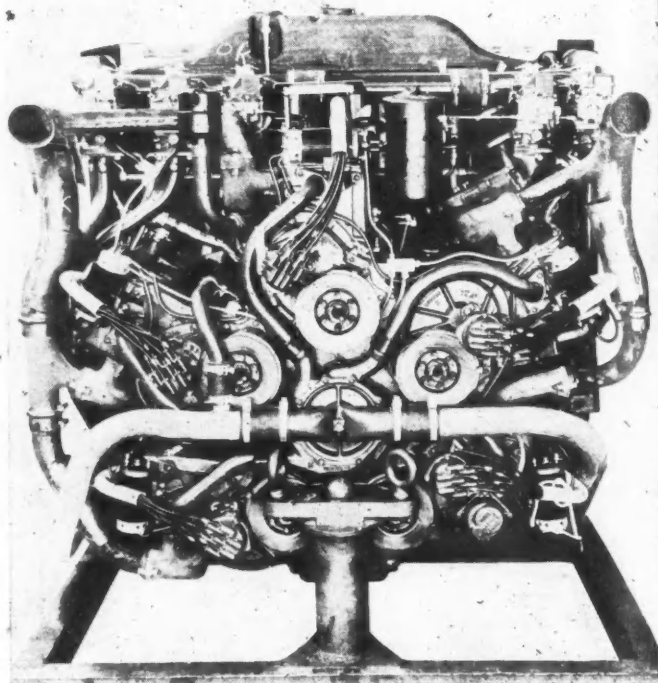
Several of its features contribute to mass production methods, including a cast crankshaft and flywheel; one-piece copper-silicon steel valve operation push rod, simplification of vertical drive shafts by using a cone worm gear on one end and a standard worm gear on the other end to drive the twin camshafts, centrifugal casting of cylinder liners, and the use of refrigeration units, instead of liquid air, for shrinking cylinder block sleeves before insertion.

Each cylinder has four valves operated by dual camshafts for each cylinder bank, making a total of four camshafts in the engine.

Most important feature of the engine, both in production and combat service, is the fact that it contains five major sub-assemblies. The cylinder block is fitted with all main bearing caps and studs before another part is added. The cylinder head is assembled complete with valves, camshafts, drive gears and the exhaust manifold. Crankshaft and flywheel are combined in a unit;



Front (left) and rear (below) views of Chrysler Multibank powerplant for medium tanks. It is formed by grouping five Chrysler six-cylinder automobile engines around a central shaft.



carburetor and heater box are added to each other; the accessory drive powers water pump, magneto, oil pump, fan and generator.

The engine is manufactured in the Detroit Lincoln plant, where a foundry has been established to help speed production. The foundry turns out castings of secondary aluminum for the cylinder block, cylinder head and oil pan.

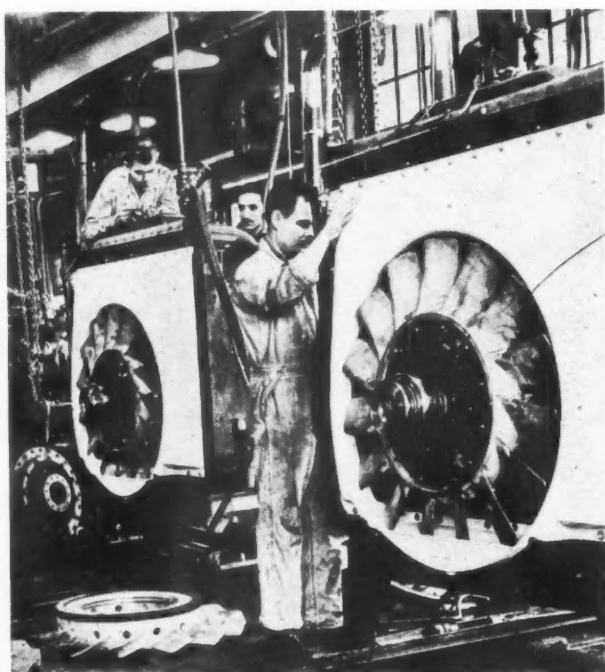
Chrysler Multibank Engine

The Chrysler medium tank engine is made by grouping five Chrysler engines of the standard six-in-line automobile type around a central shaft. Minor modifications were made in the design of the component en-

gines to fit them for service in the tank unit. The power of the five engines is combined by the use of gears assembled in a transfer case. The center of the crankshaft of each engine is located in a common circle and in place of a flywheel at the end of the crankshaft, each engine has a constant-mesh gear which is in contact with a driving gear inside the transfer case. These driving gears, in turn, drive a larger gear which is connected to the main drive shaft through the clutch. By this arrangement, all five engines are combined and transmit their power to the transmission through one drive shaft.

Each engine has its individual carburetor. The electrical system is a 24-volt system. The oiling system is of the pressure type, combining both full flow and by-pass filtration. In addition a scavenger pump has been provided to pick up the return oil from the crankcase and force it through the oil filters and oil cooler before returning it to the engine. In this way, the oil temperature is controlled.

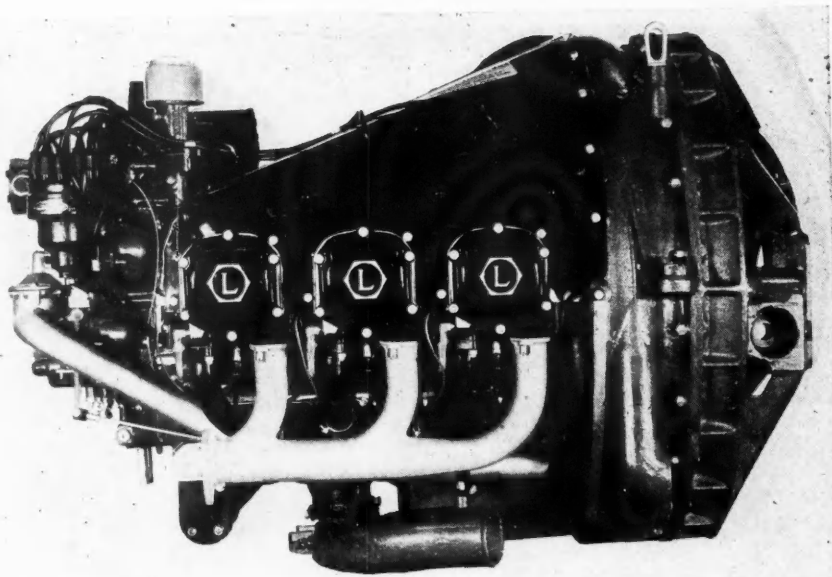
The power plant is complete with cooling system and clutch as a part of the engine assembly. The cooling system is of the pressure type.



Fan and radiator are being installed on a Chrysler multibank tank engine after it has been through the dynamometer tests. Inside the fan are the clutch assembly and power take-off shaft.

Lycoming "Packaged Power" Unit

Side view of the new engine.

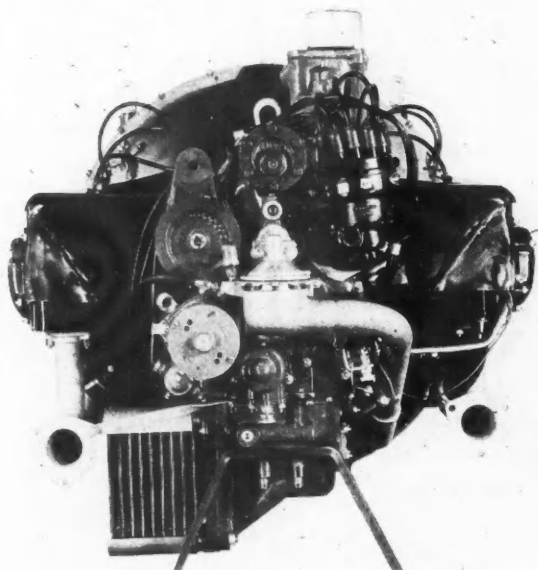


A COMPLETE, self-contained "packaged power" unit, which consists of a six-cylinder, horizontally opposed aircraft engine with all accessories, plus a clutch and flywheel, has been developed by The Aviation Corporation's Lycoming Division. The new engine has a dry weight of 755 lbs, and develops 162 hp at 2800 rpm on 73 octane fuel at sea level atmosphere. It was designed for enclosed, or submerged installation.

The principal element of the cooling system is a 28 $\frac{1}{4}$ in., 16-blade cast aluminum fan, mounted directly on the flywheel. About one-half the volume of air propelled by the fan is used for cooling purposes and

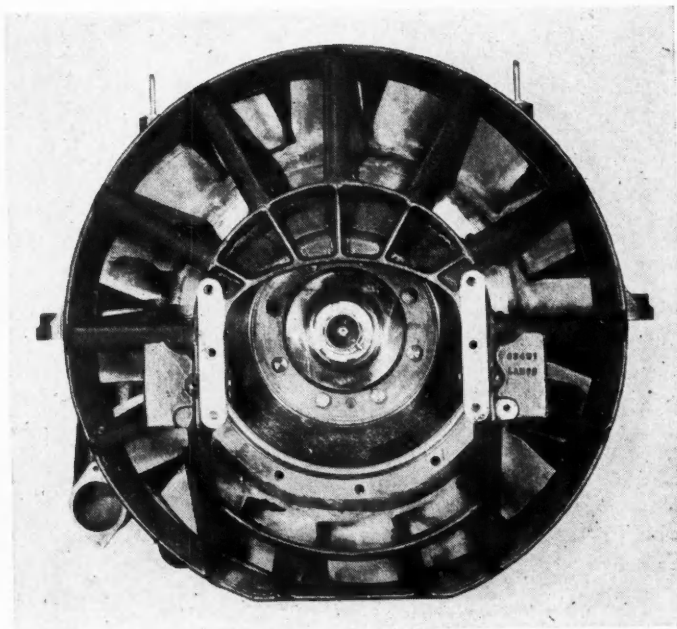
the balance to maintain ample air supply to the carburetor at a pressure above atmosphere on the intake side of the air cleaner.

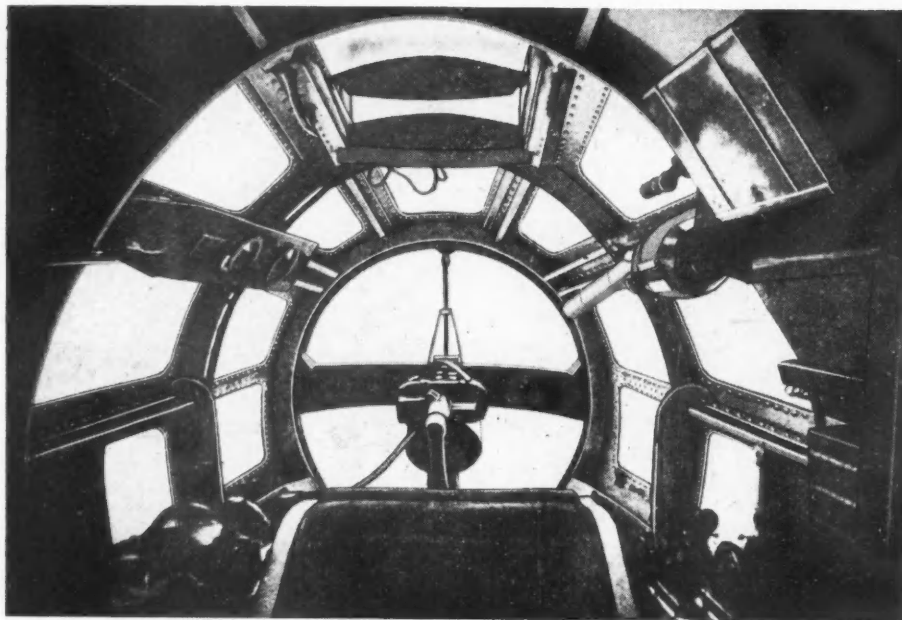
This "packaged power" unit is a modification of the standard Lycoming O-435 aircraft engine of 434 cu. in. piston displacement. A battery ignition system was provided in place of the usual aircraft magneto, and the shape of the oil sump was changed to permit a uniform over-all housing contour, in addition to the provision of the necessary cast clutch housing, flywheel, fan, and cast air baffles.



(Above) Accessory end of Lycoming "packaged power" unit.

(Right) End view showing the fan for self-cooling the aircooled power unit.



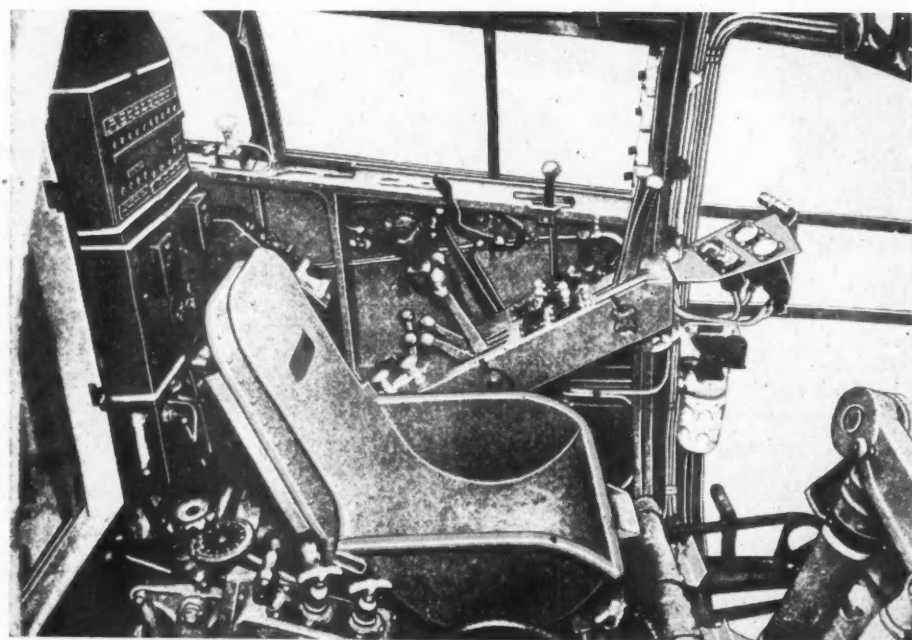
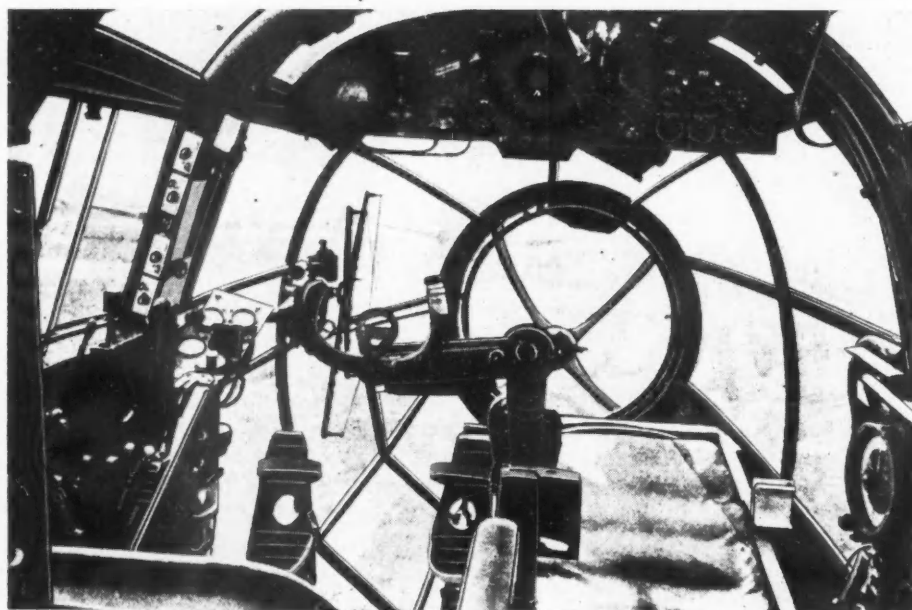


(Right) Transparent nose of the 1942 He 111 P. Bomb-aimer and pilot share nose compartment, with improved view in all directions forward.

(Left) Interior of nose of 1935 He 111, housing bomb-aimer only. Note heavier framing and restricted view in comparison with the modern design.

(Left center) Interior of nose of 1942 He 111, with wide field of view for both pilot and bomb-aimer. Note instrument panel above the pilot's forward line of vision. Back of pilot's seat on left; couch for prone bomb-aimer on right.

(Bottom) Pilot's seat on 1942 He 111, with controls on his left.



ALTHOUGH designed in its original form as far back as 1933 for use either as a twin-engined bomber or as a civil transport machine, the Heinkel 111 is still one of the most powerful weapons of the *Luftwaffe* and "one of our most modern bombers," according to the writer of a story of its development, published in a German periodical, *Motorschau*. Based upon experience gained with an earlier Heinkel, the He 70, a civil transport aircraft, the original He 111 was designed to permit of its being easily changed from civil to military use. This was done by designing two interchangeable sets of cockpits and equipment.

The prototype, which was flying in 1934, had an elliptical wing, but this feature, being found unsatisfactory from the production viewpoint, was discarded almost immediately, being replaced with a wing having straight leading and trailing edges. This change is said to have facilitated a further modification, which



Development of the

Heinkel 111 Bomber

By M. W. Bourdon

Special Correspondent of
AUTOMOTIVE and AVIATION
INDUSTRIES in Great Britain

use of this type of machine in the Spanish Civil War had indicated as desirable. The original wing was a single unit with continuous spars and metal ribs covered with fabric, but to facilitate replacements a built-up structure was adopted as a result of service experience in Spain. It was, and still is, made up of five units—central, intermediate and outer sections, with the outer sections made easily replaceable by attaching them to the intermediate sections by four simple spherical joints. At the same time the fabric covering was displaced by a metal skin.

The built-up wing was originally made with outer sections having the nose and trailing edge portions detachable to facilitate maintenance, but, experience showing this to be unnecessary, each outer section is now made as a single unit, avoiding a double web spar, thus simplifying construction and effecting considerable reduction in weight. For tactical reasons, the nose of the fuselage has been considerably modified. Originally, the pilot's cockpit was behind and higher than the bomb-aimer's compartment, the latter being at the extreme forward end of the nose, the pilot's view passing over the top of it. The alteration resulted in the pilot's cockpit being combined with the bomb-aimer's compartment, the pilot's seat being on the left and the bomb-aimer's accommodation, in the usual prone position, on the right. The framework of the transparent nose was lightened to afford a less obstructed view and the instrument panel reduced in size and located above the pilot's line of vision instead of below it. By this alteration the pilot and bomb-aimer can communicate directly and both have an almost unimpeded view of the ground, enabling both of these members of the crew to approach the target by means of a course-setting sight within

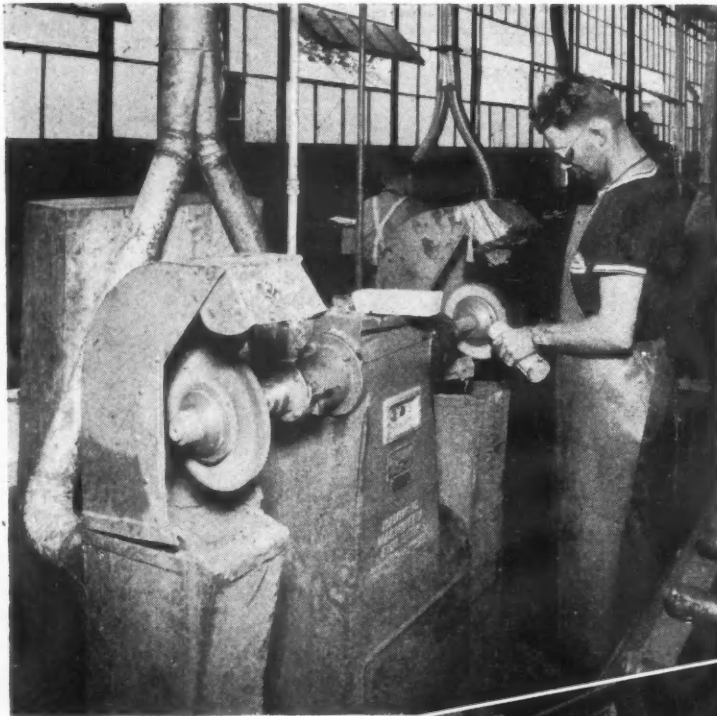
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Upper and lower gun mountings on 1942 He 111. Upper gun with transparent hood; lower gunner has prone position in trough projecting below fuselage.

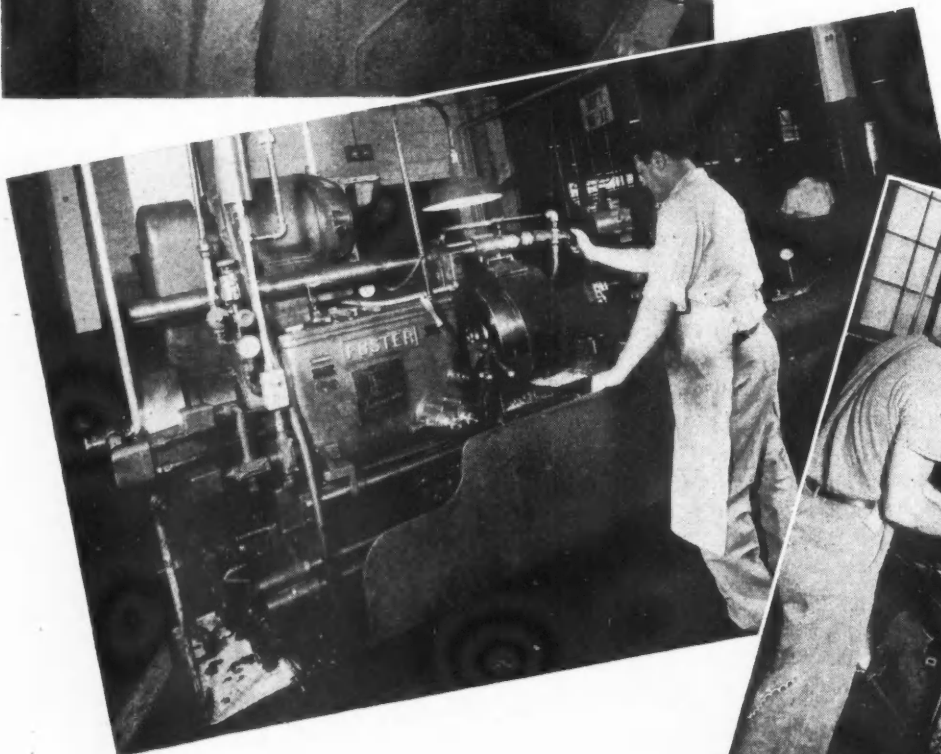
Republic Aircraft Products Specializes in

Precision



DEVOTED entirely to the manufacture of precision machined aircraft engine parts, Republic Aircraft Products, a division of The Aviation Corp., operates three plants, one of which is staffed exclusively with women operators. These plants produce a wide variety of parts of the hardened and ground precision type, and larger pieces machined from alloy steel forgings. Among these are stainless steel valve seats, valve guides, valve tappets, valve spring washer locks, crankshaft plugs, and large parts such as the locking plate which is an exceedingly intricate element. A better impression of the variety and character of the work may be gained by examining the sample board, reproduced here.

Quality control marks the major aspect of this



(Top) A view in the polishing department showing part of a battery of Hammond polishing and buffing lathes.

(Center) Foster Fastermatic is an example of the character of turret lathe equipment used in this plant.



(Right) Locking plate serrations are cut in one setting on this Fellows gear shaper.

Machined Engine Parts

operation. It begins with controlled specifications for the raw materials and includes accurate control of exceedingly fine dimensional tolerances as well as of surface perfection. Inspection procedures are painstaking. In use are various inspection fixtures, high magnification dial gages, Carboly-faced plug and snap gages, and Sheffield gages. In addition, surface quality is controlled through the use of the Brush surface analyzer as a master gage.

Republic Aircraft Products has been faced with the common problem of maintaining the full strength of its labor force under wartime conditions. This has been met by constantly increasing the employment of women for inspection and for machine operations. To this end the company has completed the establishment of a fine training center housed in a new building, in which new candidates are given a full course of instruction in the use of instruments and inspection devices, and in the operation of production machinery on actual production work. The training center is designed to turn out inspectors and machine operators who are ready to take their place on the production lines alongside of the more experienced workers.

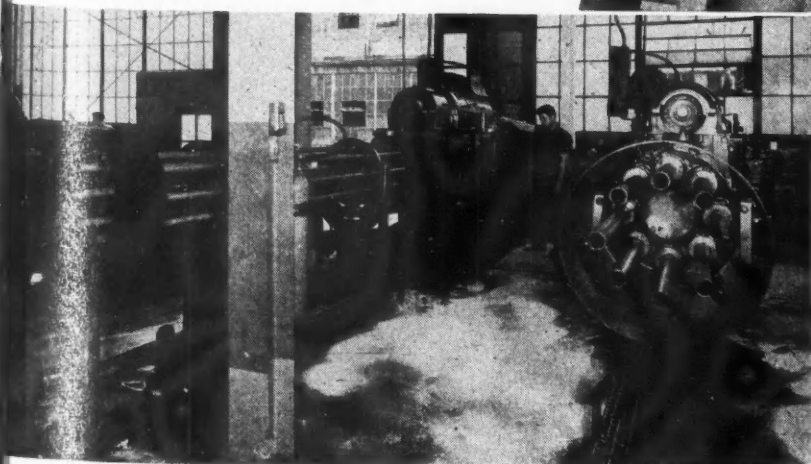
In this brief study we are concerned primarily with the activity in the headquarters plant of the group. It is generously equipped with the latest types of modern precision machinery, including familiar items such as the following. Norton grinders; Cincinnati centerless grinders, milling machines, Hydro-Tels and Filmatic grinders; several Foster Super-finishers, a large battery of Foster Faster-

matics; Monarch lathes; LeBlond lathes; a group of Conomatics, including one of the largest of this make; a battery of huge vertical OilGear hydraulic surface broaching machines; Blanchard two-wheel surface grinders; Fellows gear shapers; Heald rotary and internal grinders of many types; Ex-Cell-O precision boring machines; Micromatic Hydrohoner; Sundstrand lathes and milling machines; a large battery of bench type Walker-Turner sensitive drills.

This plant is departmentalized to handle many parts on a job-lot basis, routing such parts through the centralized screw machine and lathe department and through the general grinding department. Other parts, such as the spring lock and locking plates and valve tappet guides are processed through a completely self-contained department.



(Above) One of a battery of Mahr furnaces in the heat treating department.



(Left) Part of an imposing battery of huge Conomatics in the screw machine department.

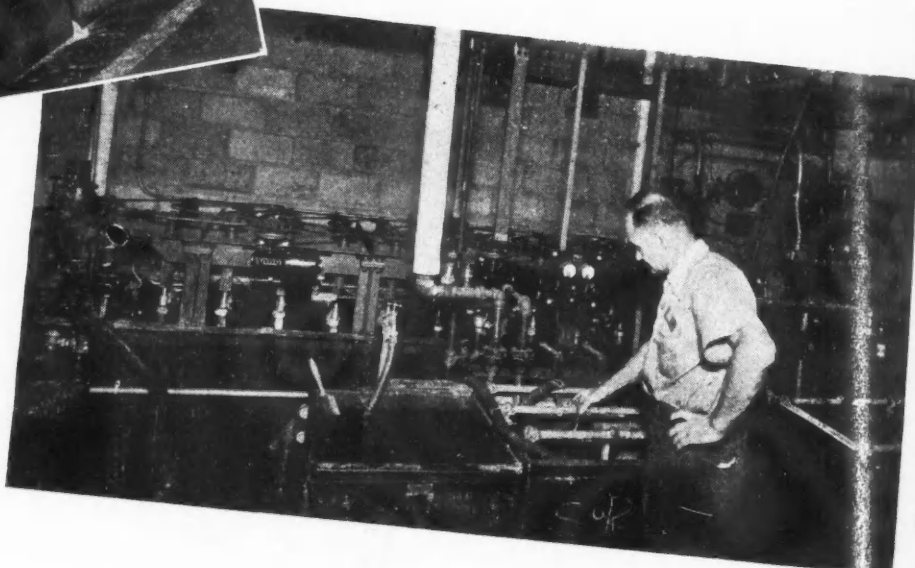


A view in the heat treating department. Here are some of the L & N Homo and Homocarb equipment, Gleason quenching machines, and others.



(Above) Towering Oilgear surface broaching machines handle the slotting and cutting of flats in valve guides.

(Right) Corner of the Udylite silver-plating department for the electroplating of an amazing variety of sleeve bearings, thrust bearings, etc., which require a silver alloy bearing material. In the background is an automatic plating machine.



The heat treating department, serving all three plants, is housed in a separate building. Here will be found a large battery of L & N Homo and Homocarb electric furnaces, a battery of box-type Mahr Mfg. Co. furnaces, an American Wheelabrator, several Dextrex vapor degreasers, and a battery of Gleason quenching machines. One corner of the heat treating plant houses a newly installed

Udylite silver plating department as well as electroplating equipment for producing coatings of nickel, copper, cadmium, etc.

The main plant boasts a recent building addition, attesting its modernity by the installation of a bus duct power distribution system supplied by Bull-Dog.

In the interest of speeding up metal cutting operations on the alloy steels and stainless steel processed here, many of the lathe and screw machine operations are tooled with cemented-carbides, principally Carboloy. These applications are being widely extended in keeping with the fine record of increased productivity and improved surface finish already demonstrated by the current use of Carboloy. Cemented-carbides are used also on precision boring machines for boring, facing, and radius turning operations. This program is being accelerated by designating an applications engineer to follow progress and by the expansion of the tool grinding department to provide separate facilities

for handling all of the cemented-carbide tooling.

The production-wise management is constantly on the watch for improved methods and techniques and has made major contributions to increased productivity and cost reduction by the introduction of new methods and advanced equipment.

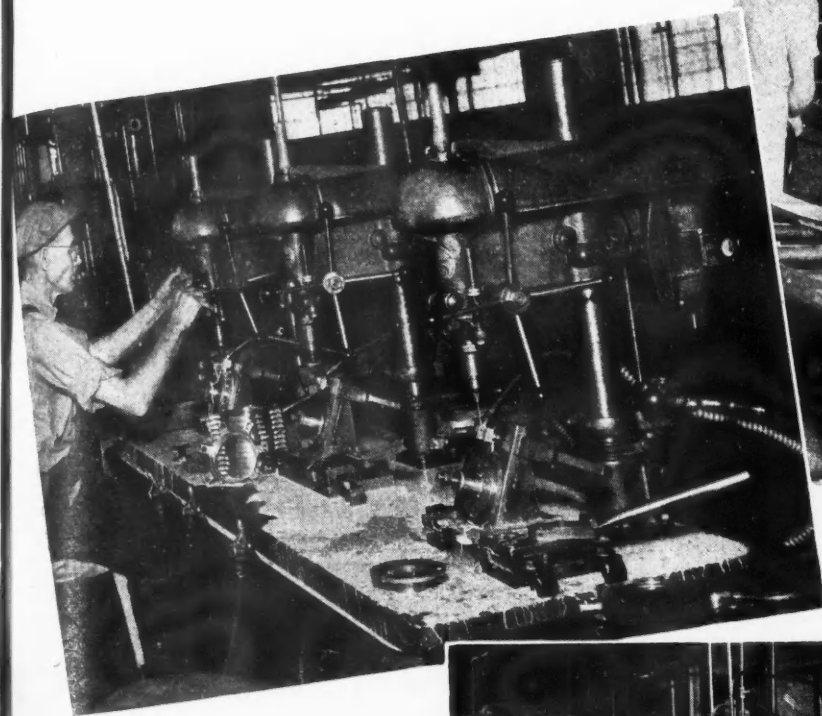
With this sketchy background, let us consider a few specific examples of production practice. First of all, it may be well to touch on several phases of the manufacture of valve guides. Following turning operations, the work goes to the battery of OilGear vertical surface broaches. On one machine, the work is handled two pieces at a time, in special indexing fixtures, to produce two flats on the flange of the guide. This is done in one pass of the ram, using a set of four flat broaches. Another OilGear broach is set up to cut the deep slot in the cylindrical end of the guide, using a thin slitting broach for the purpose. This machine, too, handles two guides at a time. The slot is subsequently finish-ground to the required tolerance.

The valve seat is produced in more or less conventional fashion with methods and tooling adapted to handling the stainless steel alloy. Initial turning and

boring are done on New Britain-Gridley automatics, followed by grinding on Heald rotary grinders, grinding radius on a Heald internal grinder, and grinding the seat angle on a Heald machine. Finish-grinding of the large face is done on a Heald rotary grinder, finish-turning of the OD radius on a Monarch lathe.

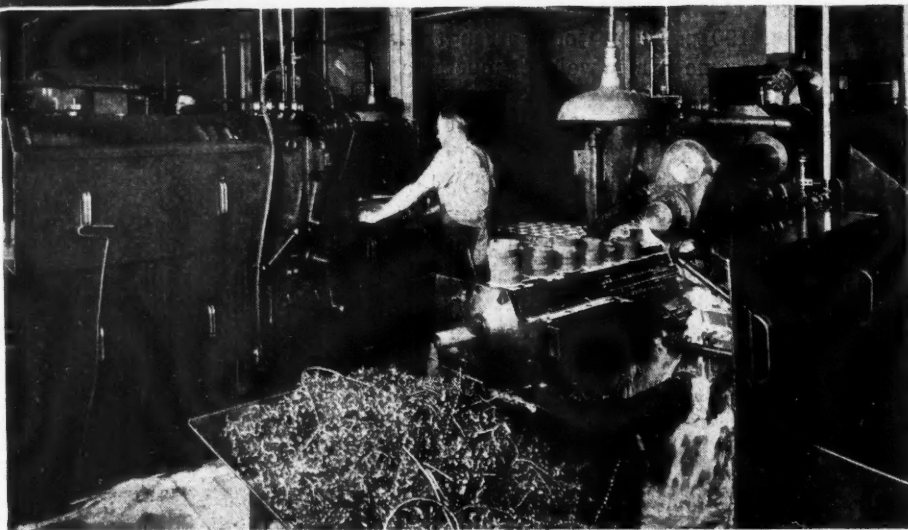
One of the interesting operations on the valve seat
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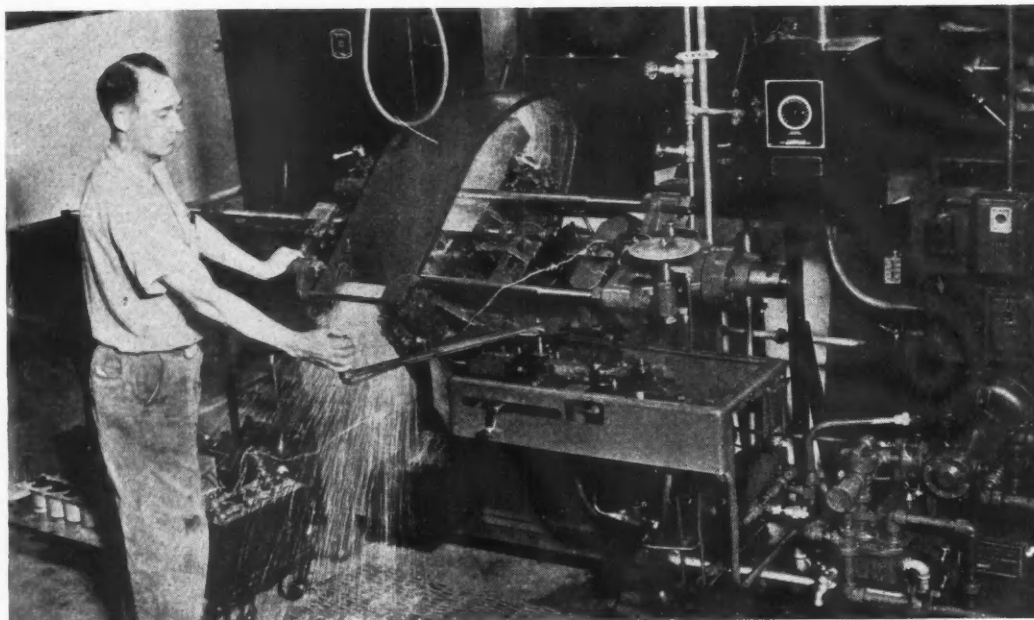
(Below) A four-spindle Cincinnati Hydro-Tel is used for roughing out the formation of ears or lugs on locking plates. Portion of the Matthews gravity roller conveyor line may be seen in the foreground.



(Above) Small precision drilling operations are handled on a variety of drill press equipment, including many items of the versatile Walker-Turner drills shown here.

(Right) Part of a battery of large New Britain-Gridley automatics for rough- and finish-machining of valve seat inserts which come in as stainless steel forgings. Note the heavy chips removed with cement-carbide tools.





Taylor Winfield flash welder in operation.

**By
Robert
Milmo**

Research Engineer,
Lockheed Aircraft
Corp.

Applications of **Flash Welding in Aircraft**

ALTHOUGH the flash welding process has been in common use for some time, the aircraft industry only recently extended it to the fabrication of structural parts. While the automobile industry, in particular, has made extensive use of the process, the problems of aircraft construction are somewhat different, and in many cases, more exacting. A great many aircraft parts are made from high-strength alloy steels with air-hardening characteristics, such as SAE 4130, which is often heat treated up to a hardness of high degree; and the newer NE 8630 steel, which has somewhat similar characteristics. Again, many parts are made of thin-wall tubing with ratios of diameter to wall thickness of 20 or more. On all such parts, 100 per cent joint strength is desirable, and at the same time weight must be held to a minimum.

The advantages of the flash welded joint over the fusion welded joint include better physical characteristics (100 per cent joint strength), lower weights, cheaper and faster production, no warping as a result of welding, and less operator skill required. SAE 4130 tubing joints welded in the normalized condition, with no further heat treatment, exhibit physical characteristics equal to that of the parent material, when tested in static tension, tensile fatigue and tension impact.

No important improvement in these properties is obtained by normalizing or annealing the weld zone after welding. Parts may be heat treated to any desired strength after welding, with no reduction in strength in the weld area. Excellent physical test results have also been obtained with welded joints in which the component parts have been heat treated up to 140,000 psi before welding, with no heat treatment after welding.

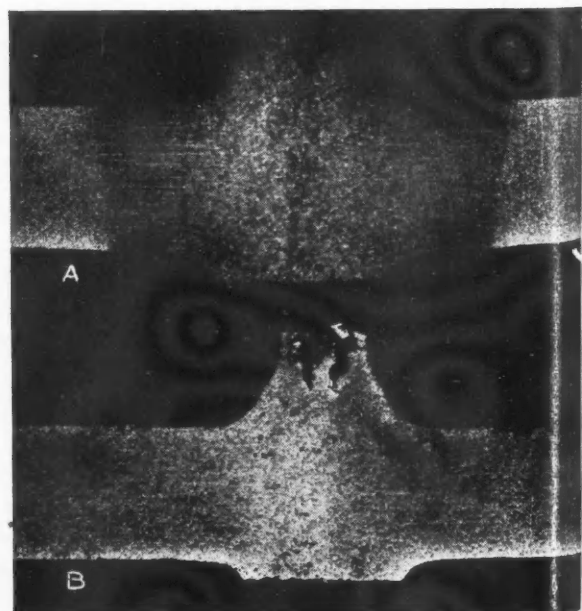


Fig. 1—A—Macrophoto of flash weld section before heat treatment. B—Macrophoto of flash weld section after heat treatment.

Macro photographs of typical flash welds in the as-welded and heat treated condition are shown in Fig. 1.

Types of Applications

To date, most of the applications have been on tubular and solid round parts, although many aircraft companies have used the process on other types of sections. These may be either light non-structural parts, such as tank filler connections, or the heaviest primary structural parts in the airplane, such as landing gear and engine mount supports. Typical parts include the common end-fitting to tube joint, in which the fitting may be a forging or may be machined from bar stock, or another piece of tube. Fig. 2 shows some representative structural parts, with comparative weight data for different welding methods.

Design Considerations

While it is, of course, preferable to design new parts especially for the flash welding process, it has been found entirely feasible to convert parts which are being arc or gas welded, without disrupting produc-

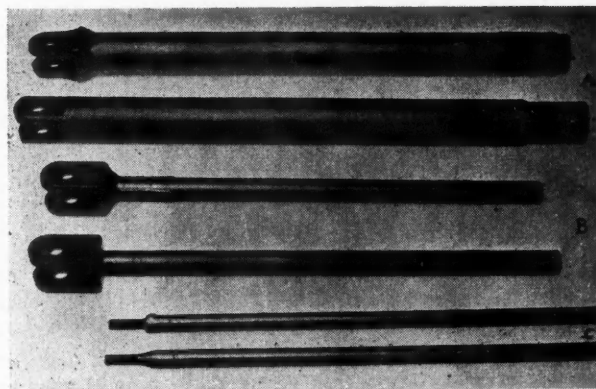


Fig. 2—Comparison of arc welded to flashweld parts.

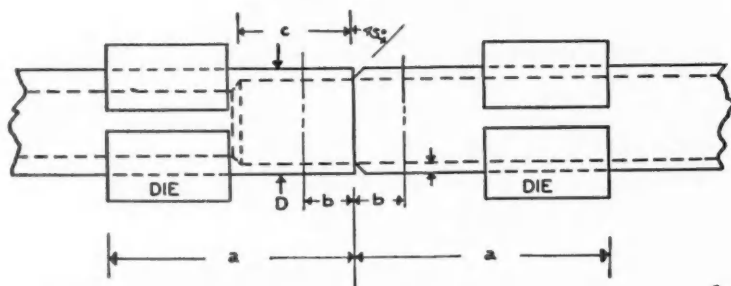
	(A) #233902 pounds	(B) #233761 pounds	(C) Exp. Control Rods (Torch Welded) pounds
Arc welded ...	2.5	1.6	.49
Flash welded .	2.1	1.5	.45

tion schedules. In many cases the original end-fitting forging may be used by simply turning and boring the end to be jointed, instead of machining it to the usual "fishmouth" shape for fusion welding. In other cases, where the forging has been designed for the "fish-tail" type of joint, it may be necessary to rework the forging dies. However, in many instances,

it has been found more economical to make such fittings from bar stock, or, as in the case of fittings with female threaded ends, from tube stock.

If the final use of parts is to be in the normalized condition, or at comparatively low heat treatments up to 140,000 psi, all component parts may be final machined before welding. Since the flashwelding process does not result in a warped assembly, these completely finished component parts will join in a finished assembly which, with modern welding equipment and tooling, will be within customary tolerances of ± 0.010 in.

Production



- D = OUTSIDE DIAMETER, CONSTANT OVER DISTANCE a
- t = WALL THICKNESS
- a = MINIMUM REQUIRED LENGTH OF CONSTANT OUTSIDE DIAMETER PER PART BEFORE BURN-OFF
- b = BURN-OFF LOSS PER PART
- c = MINIMUM REQUIRED LENGTH OF CONSTANT THICKNESS PER PART BEFORE BURN-OFF

b	t	D	c
0.313	0.156	0.375	0.500
		0.500	0.625
		0.750	0.750
		1.000	0.875
0.256	0.063	1.250	1.000
0.219	0.065	1.500	1.000
0.180	0.049	2.125	1.000
0.125	0.035		

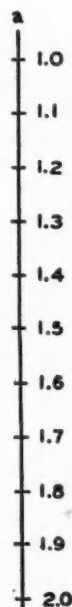


Fig. 3—Burn-off loss and required lengths for parts to be flash welded.

Given: D and t. The corresponding value of "a" is the intersection of the straight line connecting D and t with the "a" line. The value of "b" varies only with t and is read opposite the t scale. The value of "c" varies only with D and is read opposite the D scale.

Tolerances and Location

However, to obtain these close tolerances on the finished part, the designer must provide reference points on the parts, and must call for such finished dimensions from points that can be used as locators on the welding machine. For example, the centerline of a hole in a clevis-type end fitting may be readily located by a locating fixture on the welder. The end of a threaded fitting, or a shoulder on a solid type of fitting will also serve as suitable locators for the backups on the machine, which are so necessary if finished dimensional tolerances are to be maintained.

While these close tolerances may be held readily, it should be evident that they require more time for set-up in the shop, and require more skill from the operator. For this reason the designer should not call for a tolerance of ± 0.010 in. on the overall length of a part which has threaded fittings at one or both ends such as a push rod, and where the part is obviously meant to be used as an adjustable component in a final assembly. It also seems rather unnecessary to require a part three or four feet long to be held to a three or four thousandths tolerance, unless it is to be made and inspected under constant temperature conditions, since a steel part 40 inches long will vary 0.003 in. in length with a ten degree Fahrenheit temperature change. Fig. 3 is a chart which may be used by designers in determining the amount to allow for burn-off and for die grip.

Special Features of Flash Welding Machine

The successful production fabrication of aircraft parts, particularly from SAE 4130 tubing, requires certain changes in construction features of the conventional flash welding machine. These steels differ basically from the usual materials, in that much greater forces are required for forging the parts together at the end of the flashing process. Equipment ordinarily available provides from 8000 to 10,000 psi of cross-sectional area to be welded, while it has been determined that approximately twice this force is required for successful welding of SAE 4130, due to its higher strength at elevated temperatures.

It has also been determined that for SAE 4130 and similar steels, the time relation between the upsetting, or forging action, and the cutting off of the welding

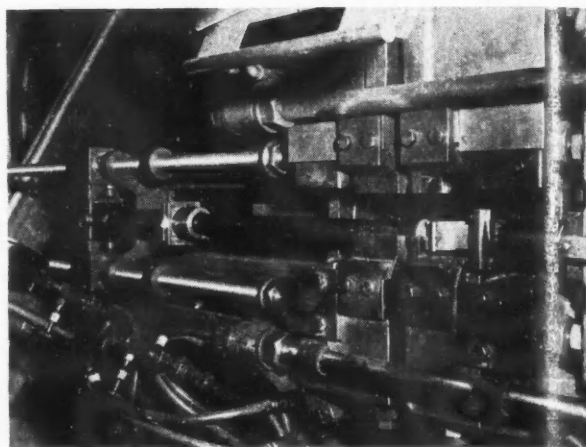


Fig. 4—Typical locating fixture.

current is quite critical. With common use in aircraft construction of tubing with walls as thin as 0.035 in., it is also necessary that the flash welding machine be built to permit accurate adjustment of the clamping dies, and that this adjustment shall remain constant throughout a production run.

It will be realized that present aircraft production lots include only a limited number of parts, and that frequent changes of machine setup are thereby necessitated, since we have seen that these travel-time-current relations are critical for aircraft steels. Also, the majority of the present standard mechanically operated machines do not have the inherent accuracy in these features that is believed to be so necessary.

For these reasons, the hydraulically-operated equipment is finding a wide acceptance in the welding of structural parts having cross-sectional areas from one-half to five square inches or more. The general arrangement of dies, platens, etc., for this type may be the same as for the mechanically-operated type, the main difference being in the method used for controlling the travel and speed of the platen, and the timing of the welding current. The motive power is furnished by a motor-operated pump capable of developing 1200 psi or more, such pressure being under accurate adjustment and control by suitable regulating valves. The hydraulic fluid, usually SAE 10 oil, is metered, under pressure, to a main cylinder whose piston is connected to the moving platen of the machine. The metering, or throttling, valves are controlled by a miniature adjustable cam, or other suitable and readily adjustable or interchangeable means, in such a manner that the travel-time characteristics of the piston, and therefore the platen, are accurate reproductions of the adjustable cam or other device. The overall time of operation is also readily controlled by the same means. Micro-switches, which may be very accurately adjusted and set, are also operated by means of this monitoring means. It is thus seen that a small, easily adjusted mecha-

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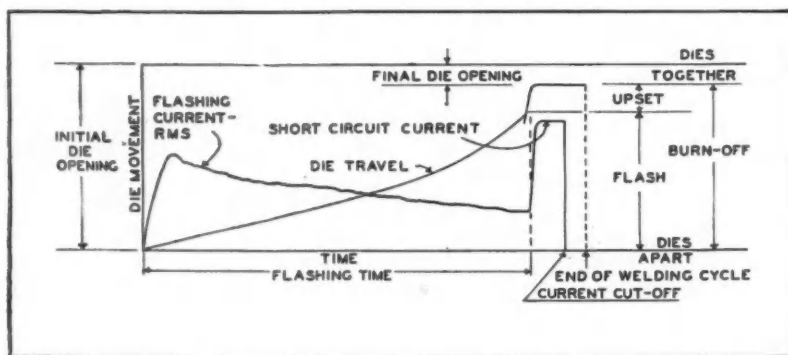


Fig. 5—Time travel diagram of a typical flash welding cycle.

Timely Technical Problems Discussed at

SAE National Aviation Meeting

THE second wartime National Aircraft Engineering and Production Meeting of the Society of Automotive Engineers early in October at Los Angeles was the largest ever held on the West Coast. Over 1600 prominent engineers were in attendance at the sessions, which were sponsored by the SAE in cooperation with the Aeronautical Chamber of Commerce of America, Air Transport Association of America, and National Aircraft War Production Council. C. L. Johnson, chief research engineer of Lockheed Aircraft Corp., was the general chairman.

At the general session, which was designated as the semi-annual business meeting of the Society, Maj.

Gen. Delmar H. Dunton of the Army Air Service Command was the principal speaker. The Manly Memorial Medal was awarded to John Dolza and Harry C. Karcher of the Allison Div., General Motors Corp. SAE President Mac Short and other officials of the National organization attended the various sessions. Twenty-six National and local manufacturers exhibited products at the Aircraft Engineering Display.

Discussions at the technical sessions centered around papers on aircraft field maintenance, propellers, engines, accessories, powerplant installation, airframe structures, and production. Abstracts of the papers follow:

Flight Testing with a Propeller Thrust Meter

By George W. Brady,
Chief Engineer, Propeller Division,
Curtiss-Wright Corp.

THIS paper describes some of the work accomplished during the past several years by the Curtiss-Wright Propeller Division in endeavoring to make a measurement in flight of thrust horsepower available. To date, this work has been based on the measurement of propeller shaft thrust, which can then be used to calculate an ap-

Fig. 2—Flight test results—variation of apparent or "shaft" thrust with airspeed.

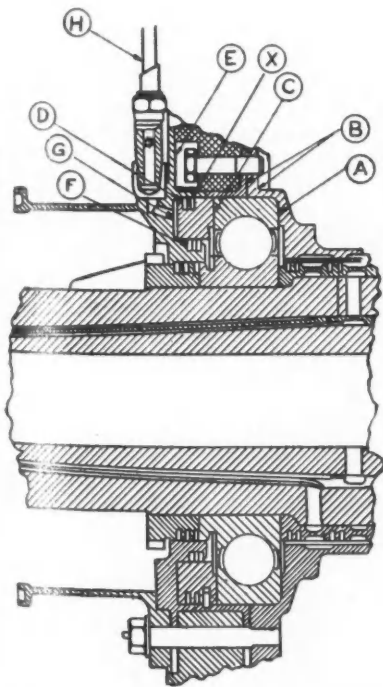
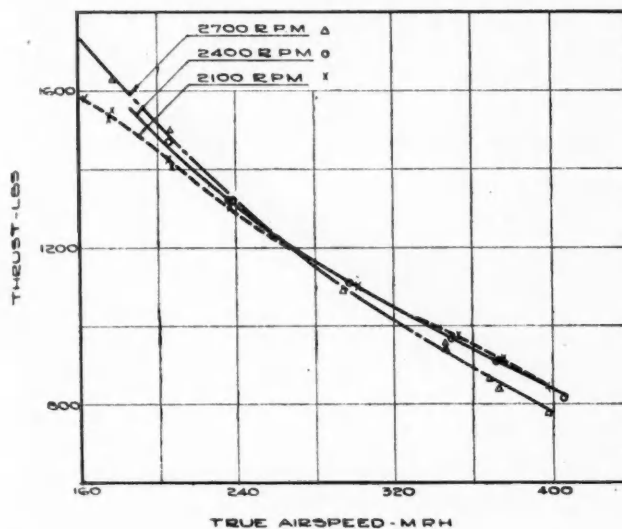


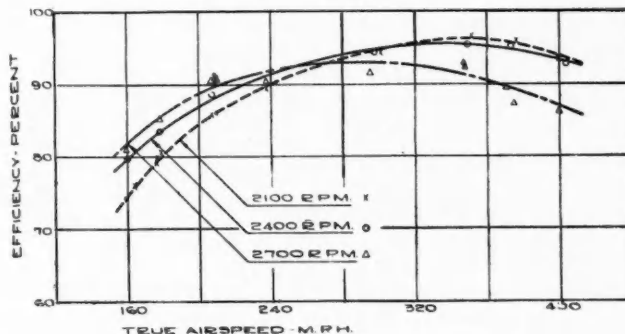
Fig. 1—Section through engine nose with thrust meter installed.

parent or "shaft thrust" efficiency.

In a typical radial engine, the Wright R-1820—C200, the thrust meter was applied to measure the force on the outer race of the thrust bearing. The general arrangement of the design is shown in Fig. 1. The outer race of thrust bearing A is provided with a slightly looser fit than is used in the

standard engine in order to permit it to slide more freely in the retainer insert B. Mounted in housing E, which replaces the thrust bearing cover plate ordinarily supplied with the engine, is an annular piston C which bears against the outer race of the thrust bearing. Two sets of piston rings, D and F, provide the seal for a cylindrical

Fig. 3—Flight test results—variation of apparent or "shaft" thrust efficiency with airspeed.



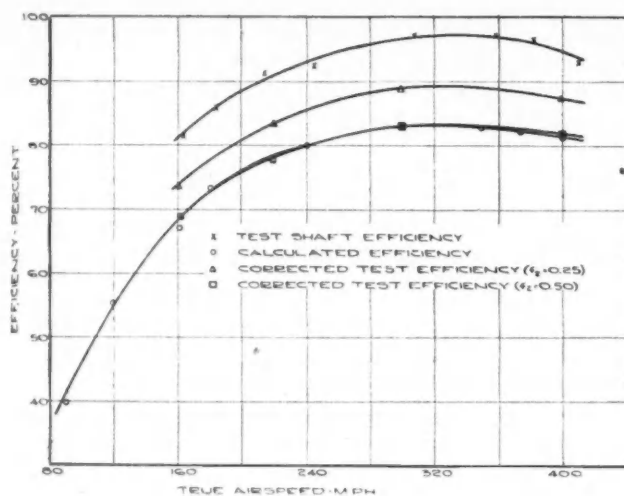


Fig. 4—Comparison of propulsive efficiencies determined by test and calculation for 2400 r.p.m.

space G between the piston and the housing into which oil under pressure can be pumped. A series of six orifices X are provided in the housing to permit the piston to find a position where the pressure from a constant displacement pump supplied through supply duct H will just balance the thrust force on the bearing. Then by measuring the pressure in the cylinder with a gage and knowing the area of the piston, the thrust may be computed. Provision was made for thrust measurements up to 2500 pounds. Electrically heated oil lines were used to prevent a lag in the meter reading due to congealing.

In making the first flight installation assistance was obtained from the Navy Bureau of Aeronautics in the form of a Brewster F2A-2 airplane equipped with a Wright R-1820 engine with a 0.667 gear ratio. Test results obtained with one typical propeller, Curtis model C532D with 89306-22S blades are given in Figs. 2 and 3, which show shaft thrust and shaft thrust efficiency variation with airspeed, all at 850 hp. and 14,000 ft. altitude.

Even though experimental data are not available, from a theoretical standpoint it is possible to make an approximate calculation of the thrust increments which make up the difference between the apparent and propulsive thrusts and efficiencies. This has been done for one of the test rotative speeds, and the results are plotted in Fig. 4, for comparison with the test results and also with a calculated efficiency, the latter being determined by the standard Curtiss method for propeller efficiency calculation.

Use of shaft thrust measurements in routine flight testing to check calculated airplane performance does not appear very practicable until additional data by which the several corrections can be more accurately determined has been obtained. However, it is believed that the more precise knowledge of the actual behavior of the propeller which can be obtained by thrust meter tests should lead the way to some improvements in airplane performance.

Analysis of a Captured Composite Propeller Blade

By W. L. Greene and A. R. Crocker, Engineering and Research Corp.

THIS captured German propeller blade was probably the type used on a Junkers Ju 878 Stuka dive bomber, which was powered by a Junkers Jumo 211D engine having a sea level take-off rating of 1080 hp. at 2400 rpm. and geared 27 to 16. With this engine the Ju 87B had a high speed of about 210 mph. The propeller was 11 ft. 2 in. in diameter, three-bladed, and had a VDM electric controllable-pitch hub.

The blade was of composite wood, plastic, and metal construction and combined parts of both the Schwarz and Jablo processes. It had the following general characteristics (see Fig. A): The root section was partially impregnated compressed wood which ran to the tip of the blade in steps of reduced density. Low-density natural wood panels were glued to the leading and trailing edges of the block. The wood core was covered with wire gauze and a plastic mantle. The compressed wood root was threaded; a steel ferrule was screwed over it and pinned in place. This ferrule supplied means for fastening the blade to the hub mechanism. The complete blade and ferrule weighed 59 lb. 8½ oz. and the blade section proper had an average specific gravity of 0.89.

The predominating features were the unusually large blade width and very

small thickness ratio. The maximum blade width ratio was 0.12, which occurred close to 50 per cent of the radius. At the three-quarter radius the blade width ratio was 0.097. This larger blade width was probably necessary to lift the highly loaded Ju 87B off the ground. The activity factor was 125, which lies near the maximum extreme of present American designs. The thickness ratio decreased from 20 per cent at 0.30R to 10 per cent at 0.50R and 8.2 per cent at 0.75R. Customary practice is that wood blades require greater thickness than similar metal blades in order to have sufficient strength torsionally. At airfoil speeds close to the velocity of sound the compressibility effect on thick sections is greater than thin sections, resulting in lowered blade efficiency. However, the German blade maintained a thickness ratio nearly as low as the average aluminum alloy blade. The pitch distribution was quite normal. The 30 deg. blade angle at 0.75R was computed as being close to the probable high speed blade angle. The tip speed at static thrust was 830 ft. per sec. and the helical tip speed at high speed was 883 ft. per sec.

Fig. B shows a comparison of the camber side ordinates of the Clark Y,

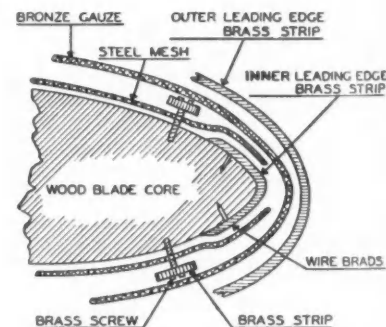


Fig. A—Exploded view of leading edge assembly of German composite propeller blade.

RAF-6 and German airfoil sections in non-dimensional units. It will be noted that the forward and after part of the German airfoil is thinner than the other two airfoils. This shape was pos-

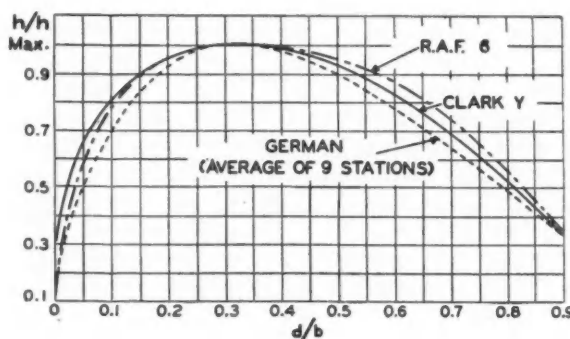


Fig. B—Comparison of camber side airfoil section ordinates.

sibly designed to utilize a particular profiling method.

The type of construction here used resulted in a much lighter blade than any metal blade of the same diameter and activity factor. Considering the operating tip speed and the thickness of the airfoil sections it is probably the aerodynamic equivalent of most metal blades. However, the construction is quite complicated, and probably more time was required to build it than would be for metal blades other than steel.

Laboratory Investigation of Altitude Vapor Formation in Aircraft Fuel Systems

By W. H. Curtis and R. R. Curtis,
Thompson Products, Inc.

FOR some time there has been a need for a method of simulating vapor formations in fuel systems so that visual examination could be directed to any condition at any point in the system, and, as a correlated procedure, a means provided of quickly determining by test the vapor forming properties, or vapor potential, of the fuel under substantially identical conditions. Thus, visual observation of vapor in a correctly simulated system would be confirmed by a vapor potential test of the fuel itself, both being focused upon the same point in the fuel system.

The accompanying diagram shows the test arrangement used to accomplish this purpose. Fuel was circulated in the simulated system at a rate comparable with requirements of many airplane engines, while imposing a rate of climb on the system as a whole and a temperature rise on the fuel as it passed from the fuel tank to the zone marked "5 psi carburetor," which represents the metered chamber in high-pressure carburetors. The zone marked "9 psi carburetor" represents the unmetered chamber. The fuel was then passed through a refrigerated heat exchanger to remove the added heat, thence back to the fuel tank at the original temperature.

At increments of 4000 ft. altitude, beginning with sea level, vapor potential samples were drawn from the line at a point carrying full carburetor pressure at maximum temperature. Samples were drawn into preheated bottles evacuated to within 100 microns of absolute zero, up to the absolute pressure existing in the 5 psi carburetor zone. While drawing the sample, conditions of pressure drop and shock or turbulence are imposed that cause the formation of an excess of vapor. The major portion of this excess is rapidly absorbed or condensed. That which persists for a two to three second period at the absolute pressure existing in the part of the system under examination is considered to be the vapor potential. Since the sample bottle is substantially free of air at the start of the draw, any space not occu-

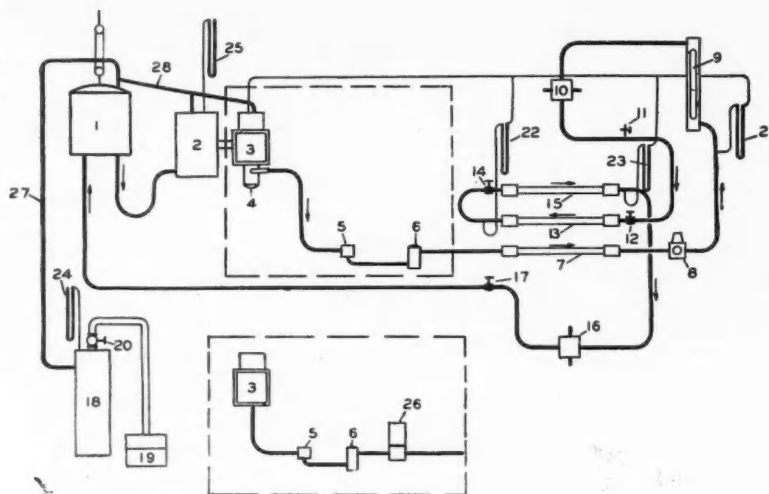


Diagram of equipment for altitude vapor tests

- 1—Fuel leveling tank—arranged to be raised or lowered to adjust fuel level in (3).
- 2—Controlled level fuel tank.
- 3—Box like extension of (2) with three transparent sides to permit view of action inside tank.
- 4—Centrifugal Fuel Booster Pump.
- 5—Selector cock.
- 6—Strainer.
- 7—Transparent section fuel line—marked "Fuel Pump Suction."
- 8—G-9 Engine Fuel Pump.
- 9—Flow Meter.
- 10—Heat exchanger to raise fuel temperature—uses hot water.
- 11—Stop Cock for drawing Vapor Potential samples.
- 12—Valve for controlling rate of fuel flow.
- 13—Transparent section fuel line—marked "9 psi Carburetor."
- 14—Valve for controlling pressure in (13).

- 15—Transparent section fuel line—marked "5 psi Carburetor" in photographs.
- 16—Heat exchanger to lower fuel temperature—uses refrigeration.
- 17—Valve for controlling pressure in (15).
- 18—Altitude tank—altitude of airplane determined by pressure in this tank.
- 19—Vacuum Pump.
- 20—Valve for controlling rate of climb.
- 21—Manometer—Fuel pump discharge pressure.
- 22—Manometer—First carburetor pressure.
- 23—Manometer—Second carburetor pressure.
- 24—Manometer—Airplane altitude.
- 25—Manometer—Equivalent altitude or pressure within fuel tank.
- 26—Electric motor driven G-9 fuel pump used in Run No. 3.
- 27—Vent line—Fuel tank system to altitude tank.
- 28—Vent line—Pressure balancing.

pied by liquid when the draw is completed must represent fuel vapor and air released from the fuel. The total vapor thus formed has been termed "vapor potential," symbol VP, to distinguish from the symbol V commonly used to designate total vapor in equilibrium. The ratio of the volume of this vapor to the volume of the fuel in the sample is indicated by the notation VP/L.

$$\frac{VP}{L} = \frac{T-L}{L}$$

where T = Total volume of sample container

L = Volume of liquid in sample.

It was found that the operation of a centrifugal fuel booster pump properly installed will reduce the vapor potential of the fuel on the discharge side of the booster. The use of an electric motor driven pump at any point in the line between tank and engine fuel pump has no effect upon the altitude at which vapor may appear in the carburetor, neither does it reduce the volume thereof. The effect of centrifugal booster operation was striking in its ability to eliminate vapor, once having been

formed, notwithstanding the fact that there was no pause in the rate of climb. In this run the booster was started when vapor appeared in the 5 psi carburetor zone, and remained in operation until this zone was cleared of vapor.

Design and Development of the North American Aviation Trainer Series

By Ralph Ruud,
Asst. Factory Manager, California Division,
North American Aviation, Inc.

THE ultimate success of a military airplane, as of any other piece of equipment, is determined on the drawing board. A training plane must be similar in performance and general handling characteristics to the combat planes to which the student pilot will graduate. It must be hard to fly yet safe to fly. It must come as close to indestructibility as any airplane can come. It must be easy to maintain and easy to repair. Above all, it must be designed for low-cost, rapid production.

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Radiographic

A GLANCE at the activities of the various aircraft plants working all-out for the war effort reveals the increasing importance being placed on X-ray inspection, which was cited in Government specifications as far back as 12 years ago. Today it is making great forward strides with the application of new techniques, especially in X-ray examination of aircraft components.

Final decision as to type of parts subject to radiographic examination depends on the character of the material, method of producing and casting such material, and the stress requirements of the part after its final installation in the finished product. X-ray inspection is essential on castings which present constitutional uncertainty owing to many factors entering into the designing and casting of the part.

By Robert Taylor

A very important factor is the stress requirements in undergoing physical tests in which hardness, tensile strength, elastic limit and yield point determine soundness. Internal conditions must be determined radiographically.

Although this article discusses cast materials, for a comparison the following are some of the discontinuities found in steel, bronze and aluminum forgings: inclusion of carbon sulphur, shrinkage pipes, porosity, gas cavities and inhomogeneity of crystal structure. The following informative deductions may be made from radiography of castings:

- Determination of gas inclusions.
- Determination of slag inclusions.
- Porosity of metal.
- Shrinkage cracks.
- Dross.
- Relationship of fault to total size.
- Homogeneity.
- Correction of mold temperatures.
- Proper gating of pattern.
- Corrections in faulty casting procedures.

Permanent mold castings are made from a permanent mold consisting of two cast iron halves. The parting surface is arranged vertically and most permanent mold or chill castings are therefore produced with the largest dimensions parallel to this vertical plane, contrary to sand castings which usually have their largest dimensions in a horizontal position. Permanent mold castings of most commercial alloys have considerably better properties than sand castings. Tensile strength of permanent mold cast aluminum alloys is at least 25 per cent higher than that of the same alloy cast in sand.

Shrinkage cavities produced because of inadequate feeding are the remains of pipes and are usually restricted to thick sections. Large blowholes result from different sources, such as the inclusion of air and gas formed by a reaction between liquid metal and mois-

ture in the sand. These are quite often found near the surface layer. Small pin-holes, sometimes perfectly spherical, are caused by gas liberated from metal before and during solidification and which is trapped in the casting.

Castings are influenced by the temperature of the melt. In the melting of aluminum alloys temperatures should be maintained as low as possible, in order to minimize oxidation losses and to prevent excessive gas absorption. Holding temperatures and periods are also kept at a minimum for the same reasons. Cast iron and magnesium alloys are exceptions and a beneficial refining action may be procured by melting at comparatively high temperatures. The effect is attributed to the elimination of particles that may serve as nuclei during solidification, e.g., graphite in cast iron. Larger crystals are formed in the presence of such nuclei than are obtained by solidification directly from a homogeneous melt.

Slags and other inclusions reduce the strength of a casting. Inclusions on the surface exact a slightly greater effect than interior inclusions. The yield strength is practically unaffected by localized inclusions.

Porosity influences the properties of many cast metals in a manner similar to inclusions. Small pin-holes in copper castings and ingots reduce the strength by 60 per cent when the volume of the pin-holes (computed by the difference in density between sound and porous metal) occupies 10 per cent of the total volume. Similar results have been obtained in brass and bronze

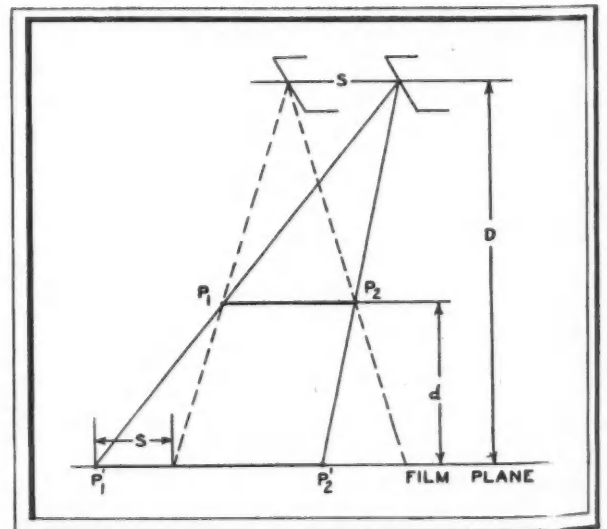


Fig. 1. Results with X-ray tube off-center with respect to casting.

Inspection of Light Alloy Castings

which are prone to form intercrystalline cavities. The blow-holes in die castings, which are fortunately located in the interior, reduce the strength according to the existing cross section. In commercial aluminum sand-castings the maximum degree of pin-hole porosity which is considerably greater than is permitted for production aircraft castings reduces the tensile strength by about 70 per cent. It would appear that porosity and inclusions also cause the stress strain line to terminate prematurely.

Cracks and shrinkage areas appear as dark regions and are caused during solidification of the molten metal brought on by centralized residual stresses. A cold shut is due to the failure of union of the streams of molten metal flowing from different directions to one point.

Turning from a brief discussion of cast materials and some of the common discontinuities encountered, the following lists defects distinguishable in X-ray negatives:

- Cracks
- Shrinkage
- Cold shuts
- Misruns
- Porosity
- Micro-shrinkage
- Blowholes
- Dross
- Sand inclusions
- Segregations

In order that flaws within a casting may be readily visualized by the inspector responsible for interpretation of X-ray radiographs, the technical application necessary to produce high quality radiographs must be carefully chosen. Radiographs must contain the proper degree of sensitivity, desired density, a minimum of distortion, excellent definition and careful selection of proper type of film.

Sensitivity is expressed in terms of the ratio in per cent of the thickness of the thinnest cavity that can be detected to the thickness of the metal penetrated by the radiation, both thicknesses being measured in the direction of the propagation of the rays, i.e., a technique which can illustrate the presence of a defect .015 in thick in a casting 1 in. thick has a sensitivity of 1.5 per cent.

To determine percentage of sensitivity so that the radiographic process can be determined, it is required that additional thin pieces of the base metal be placed on the source side of the specimen. These thin pieces of metal are called penetrameters, and must be within 2 per cent of the thickness of the base metal (3 per cent required for magnesium and magnesium alloys), with which they are to be exposed. They must have three holes drilled through them whose diameters must be 2, 3 and 4 times the thickness of the pene-

tramer and they must also contain a lead number defining the thickness of the section for which they are applicable. This leaves a reasonable check on sensitivity present in any radiograph.

The next matter of importance is that of film density. Density or film blackening in the H & D curves is defined as the logarithm of the reciprocal of the transparency of the film. That is, blackening equals $\log 1/T$. A film that is dark enough to reduce the

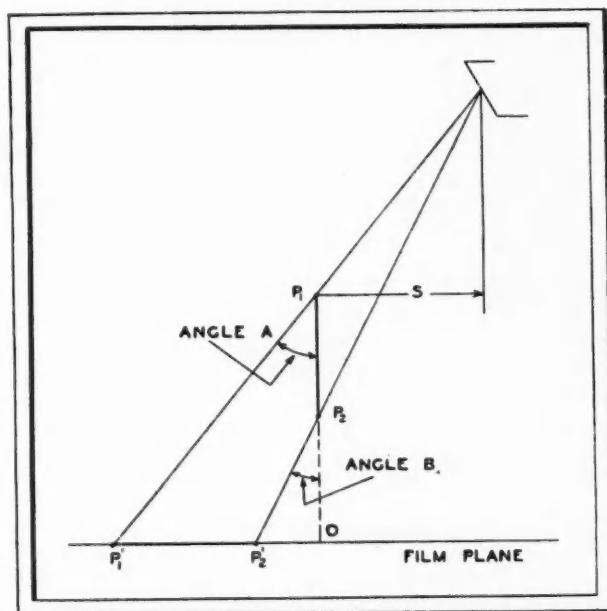


Fig. 2. Results with oblique focus.

transmitted light to 1/10th of its original brightness has a blackening of 1.0. A density of 1.0 will provide proper sensitivity and films may be viewed by cold front fluorescent illumination, whereas a density of 2.0 to 2.5 requires high intensity illumination to enable the inspector to look through the darker sections. Fig. 4 shows a graph depicting log X-ray intensity plotted against film blackening.

An additional item of importance in setting up technical procedures is the matter of reducing radiographic distortion to a minimum. Fig. 1 shows results with tube off-center with respect to specimen, in which planes of the specimen and film are parallel and the tube is off-center with respect to the specimen, and/or when the specimen and film are not parallel, the tube being off-center. In this instance the specimen with end points P_1 and P_2 is projected on the film at P'_1 and P'_2 , with the tube off-center with respect to the specimen by an amount S . The image is thus shifted to the left as the tube is shifted to the right and the resultant displacement is a function of the distance S , the

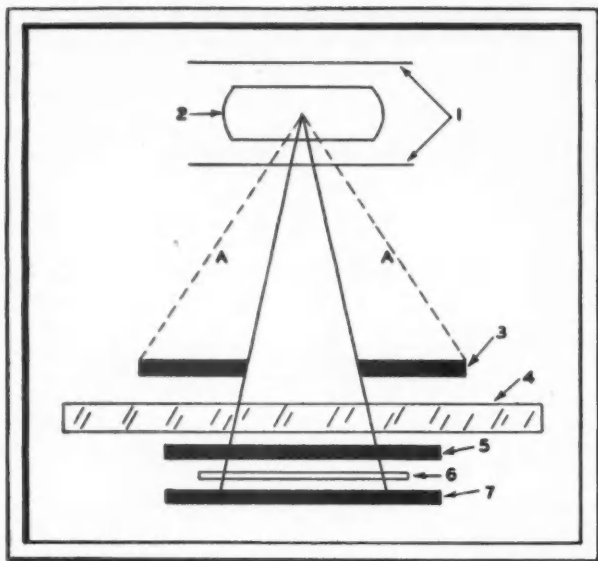


Fig. 3. Means of limiting X-ray beam.

specimen-film distance and the focus-film distance which leads to this formula,

$$S' = \frac{S d}{D-d}$$

where S' equals displacement of image on film

S equals tube shift

d equals object-film distance

D equals focus-film distance

By applying this formula, it is evident that the points P_1 and P_2 have been shifted due to the fact that the tube is off-center by an amount directly proportional to the tube displacement, all other factors remaining constant.

If the focus-film distance D is increased, relative amount of the image shift is reduced, since D appears in the denominator of the fractional factor. If the specimen-film distance d is decreased, the distortion is further reduced.

Fig. 2 shows misalignment of the tube, center of specimen and film so that the central beam is angulated with respect to the normal line. In this instance the end points of the two superimposed lines P_1 and P_2 are projected to the film by a tube whose central ray is oblique. It may be noticed that the projections P_1 and P_2 are actually separated on the film by an appreciable distance $P_1' P_2'$, despite the fact that they actually may be directly over one another in the specimen.

The separation can be readily calculated as a function of the respective specimen-film distances d_1 and d_2 , the focus-film distance D and the off-center tube shift S . Let A be the angle between the central X-ray beam through P_1 and the perpendicular and B the angle between the ray through P_2 and the perpendicular. Let O be the point on the film which would be the image of P_1 and P_2 if they were projected by a perpendicular

central X-ray beam. The distances d_1 and d_2 are the specimen film distances of the points P_1 and P_2 respectively, then,

$$OP_1' \text{ equals } d_1 \text{ tangent } A$$

$$OP_2' \text{ equals } d_2 \text{ tangent } B$$

writing the angles A and B in terms of known distances,

$$\text{tangent } A \text{ equals } \frac{s}{D-d_1} \quad \text{tangent } B \text{ equals } \frac{s}{D-d_2}$$

the separation on the film is,

$$P_1' P_2' \text{ equals } OP_1' \text{ minus } OP_2'$$

combining these equations,

$$P_1' P_2' \text{ equals } d_1 \frac{s}{D-d_1} \text{ minus } d_2 \frac{s}{D-d_2}$$

$$\text{equals } \frac{d_2}{D-d_1} \text{ minus } \frac{d_1}{D-d_2}$$

It is apparent then that objects normally superimposed can be separated in radiographic projection by shifting the tube, the separation being proportional to s .

Radiographic definition relates to the clearness (sharpness or unsharpness) in outline of the specimen as shown on the processed negative. The control of this factor is governed by the size of the tube focus, the alignment of the tube to center of specimen and film as well as the type of accessory material used, such as calcium tungstate or lead-foil screens.

Radiographs of good quality contain at all times the optimum in definition. The relation of scattered radiation to clearness of outline should be observed closely. By maintaining a minimum of scatter, clearly defined radiographs may be obtained. The effect of scattering on sensitivity and definition is greater than

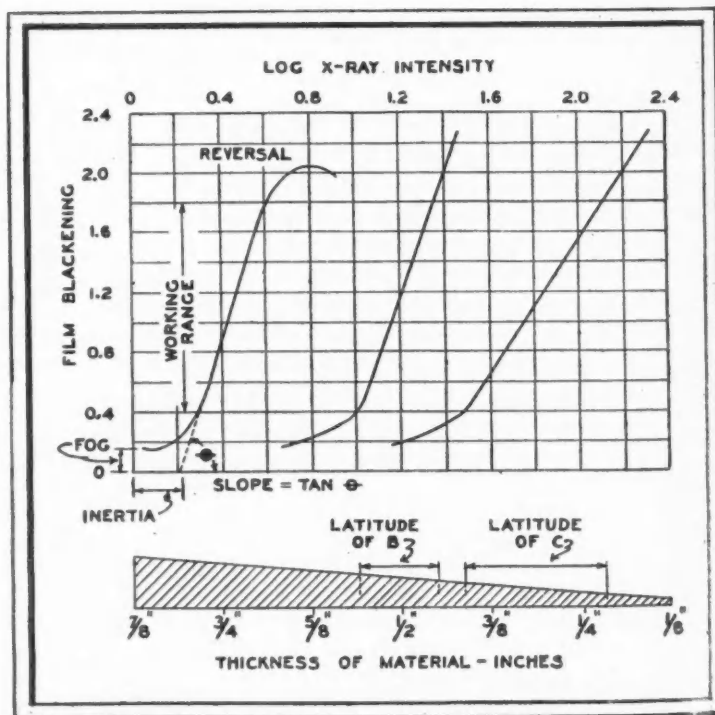


Fig. 4. Log X-ray intensity vs. film blackening chart.

INLAND'S

50TH

YEAR

OF STEEL
PRODUCTION

INLAND STEEL CO.
CHICAGO



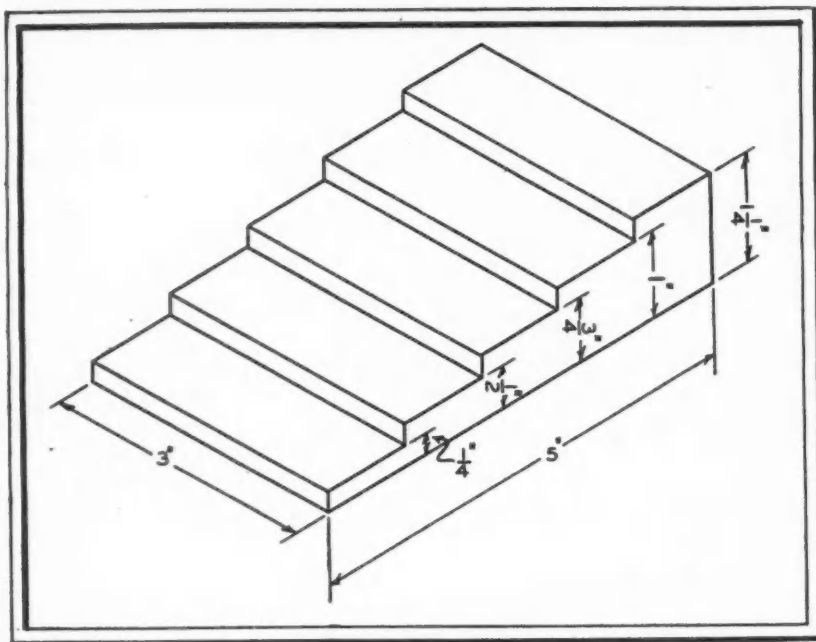


Fig. 5. Step-ladder wedge for calibration.

is realized and cases have been recorded where the intensity of scattered rays was five times that of the direct beam after passing through the casting.

Fogging around the edge of a casting is caused by external scattering and halation. For improved definition by reducing external scattering it is desirable to limit the width of the primary X-ray beam to little more than the width of the casting. Unnecessary objects should be clear of the X-ray beam. Blocking either by immersion in carbon tetrachloride or a solution of lead acetate and lead nitrate is more or less essential when using calcium tungstate intensifying screens. If blocking is not practicable, back-scatter and halation may be reduced greatly by using no-screen film with a back lead screen. Reducing the width of the X-ray beam is illustrated in Fig. 3. Scattering outside of primary beam is eliminated by such a method and improved definition results.

The matter of film is of great importance. For radiography of light alloy castings in the aircraft industry a very fine grain film is advantageous. We approve of Eastman type "A" or "M," Dupont No. 506 or Agfa Super-ray A. All such films are of fine grain and suitable for radiography of light alloys.

For this type of radiography a film need not be too fast, and of coarser grain because it is relatively a simple matter to penetrate aluminum and its alloys and magnesium. In this instance time of exposure can be kept at a minimum even with the better and finer grain film. The faster and coarser grain films make it rather difficult to delineate minute inhomogeneities often found in the lighter alloys.

The following method is one found to be satisfactory as a means for setting up techniques in the radiography of light alloy cast-

ings. A step ladder wedge as illustrated in Fig. 5 with thicknesses of from $\frac{1}{8}$ in. to $1\frac{1}{4}$ in. is constructed of the same base metal as that to be exposed to X-ray and suitable penetrameters designed according to the chart Fig. 6, are placed over each thickness radiographed, and for which thickness they are applicable. Kilovoltages range from peak 40 kv up to and including 100 kv and exposure time, focus-film distance and milliamperage are kept as constant factors. When suitable densities are discovered, a chart is drawn setting forth the kilovoltage applicable to each thickness of metal with all other exposure factors remaining unchanged. In this manner proper sensitivity and density remains a known factor for each thickness and a permanent chart is drawn which illustrates the kilovoltages applicable to any casting of any particular thickness of metal which may be encountered.

After exposures have been made for each metal (magnesium, aluminum, bronze, and steel) there is no need for additional experimental exposures. A permanent technical record is at hand, so that additional experimental steps are unnecessary and the operator has but to consult the chart to make an exposure that will reveal proper sensitivity and density suitable to the inspector. This method has proved to be valuable as a time saver, and control method, wherein numerous exposures must be made daily.

Radiographic examination is valuable to the foundryman and the inspector in different ways. It assists the foundryman in perfecting his foundry technique, so that satisfactory castings may be produced and it enables the inspector to reject castings that are defective. The foundryman may deduce information

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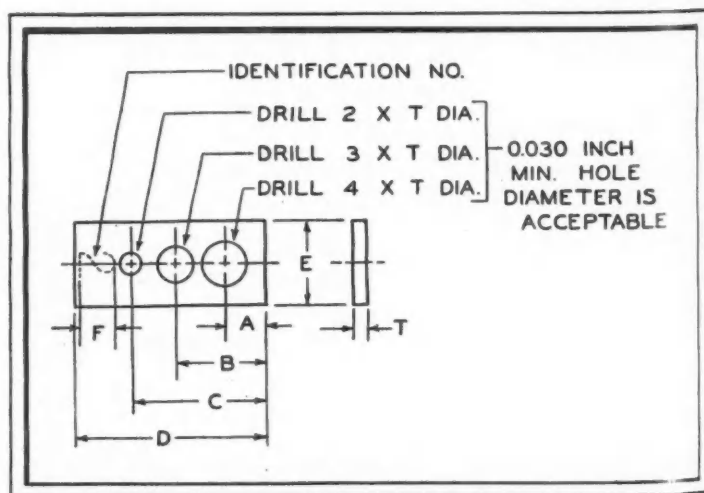
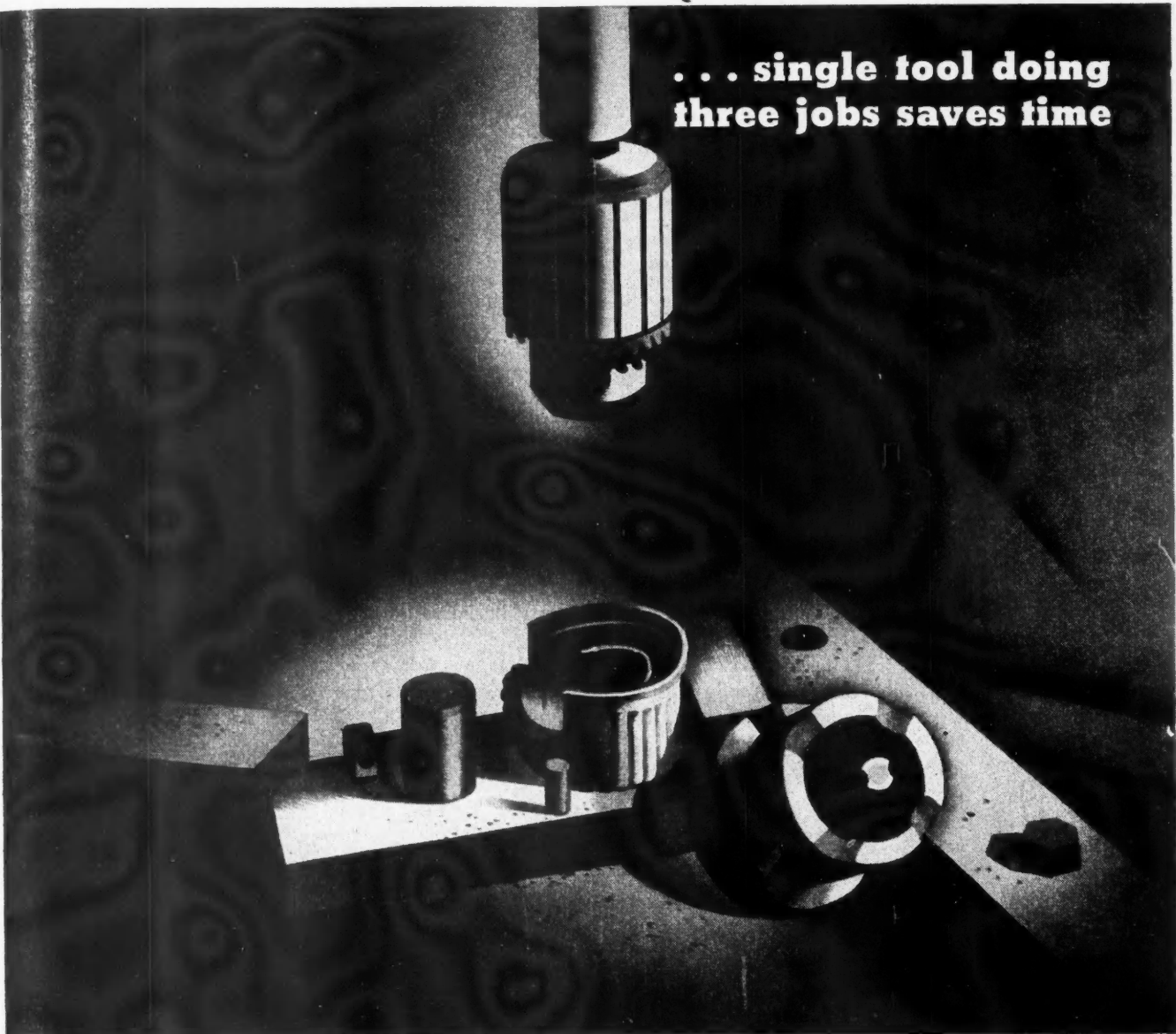


Fig. 6. Penetrameter design.

**... single tool doing
three jobs saves time**



Information supplied by an Industrial Publication

One of the best ways of expediting machining is the use of tools that make several cuts simultaneously. True, such tools must usually be specially designed, but the time saved more than compensates for the effort of developing them.

A tool developed to do three operations simultaneously on an aluminum die casting is a good example. It is a combination drill, miller and facing cutter.

The drill which cuts flash from the center hole is in the middle. It is surrounded by a four-tooth

hollow mill which removes push-out pins at the bottom of the annular recess between the inner and outer walls. Above the mill, on a flange, are four cutters that remove flash and face the top edge of the casting.

All of these operations are performed with the tool in a drill press spindle, the work being held by a simple fixture. The time saving between this method, requiring a single set-up and a single stroke of the drill press spindle, and the use of three set-ups and three tools is obvious.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING
DATA ON MOLYBDENUM APPLICATIONS.



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FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

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Air Transport *Has Its*

Share of Postwar Problems

HAVING undergone a tremendous expansion during the past three years, air transport has created a number of pressing problems in the development of airport facilities, airways systems and air traffic control, satisfactory solutions for which must be provided if the operations of that phase of American aviation are to be placed on a sound basis following the close of the war. In the recent growth of domestic and foreign air commerce is to be found a number of significant facts that are indicative of situation.

During the 1943 fiscal year the Airway Traffic Control Centers of this country handled over 11¼ million aircraft movements as compared to approximately 1½ million movements in the 1941 fiscal year. It is estimated that by 1950 the movements annually will total 53 to 60 millions for private, commercial and military aircraft, with 500,000 planes in use.

At the present time there are 35,000 miles of civil airways in the United States and in addition to them the U. S. Army and Navy have established over 140,000 miles of air routes throughout the world. A million pounds of express and mail are now being shipped weekly via air to South America.

To start 1944 this country will have 3129 airports, 600 of which will have landing strips 4500 to 5500 ft in length, 416 with strips 3500 to 4500 ft long and 900 with strips 2500 to 3500 ft long. This network of airports is being expanded with the \$400,000,000 that has been appropriated since 1940 by Congress to the Civil Aeronautics Administration. The CAA estimates that 6000 airports will be needed in the early postwar years.

The various problems confronting the air transport industry were the center of discussion in October at a symposium sponsored by the Institute of the Aeronautical Sciences in the Nation's Capital. Government and industry experts presented papers and took part in the discussions at two sessions, which were attended by over 400 prominent aviation men with Grover Loening and J. Parker Van Zandt presiding.

Except for a few airplanes that may be returned to them at the close of the war, airline operators will have to depend upon the ships they now have for sometime afterwards. William Littlewood, vice-president in charge of engineering, American Airlines, stated that unless aircraft manufacturers are permitted soon to design and fabricate conversion parts, a period of six months may elapse after hostilities cease before the air transport industry can expect to receive any additional airplanes. Based on a survey of some aircraft manufacturers, at least three months would

transpire before any converted planes can be delivered to the airlines even if the manufacture of parts was authorized today. In converting military transports, it would likely have to be done at some sacrifice in empty weight. Substantially improved transport airplanes developed from existing basic military and commercial transport designs probably will not be available for one or two years after the war, while entirely new transports can not be delivered for at least two years and possibly three or more years after the war. In fact these improved transports may not be economically desirable if the entirely new models go into production soon enough.

Air cargo handling problems encountered by the Air Transport Command in its worldwide operations were described by Col. Harold R. Harris, assistant chief of staff operations, AAF air transport command, who pointed out that the design objectives in military and commercial transport aircraft do not coincide and the

record must show that converted military airplanes have certain basic characteristics which prevent them from being the ideal solution to air trans-

port problems. Specific attention of designers was directed to the walls, floors, and doors to give transports proven reliability and accessibility.

Grover Loening, who is now consultant on aircraft with the War Production Board, foresees glider trains and air pickup service becoming the backbone of air transport in the postwar years. His observation is based on the experiences of the Army Transport Command which cannot be disclosed at this time.

Charles B. Donaldson, director of airports for the Civil Aeronautics Administration, reviewed the fast growth of aviation in recent years and the relationship of airport development with it. He explained that the CAA is revising its National plan of airport expansion and that it will be submitted to the various State and regional planning groups for comments. However, before the plan can be carried out, the policy will have to be determined by Congress. Decentralization of Federal operations and the delegation of more responsibilities on the State aviation agencies is advocated. It also was suggested that the development of the postwar airport network be done along the lines of the Federal highway system, with the State and Federal Government participating in the joint program of airport construction.

To handle the greatly expanded flow of air traffic, present control facilities have definite limitations that must be overcome, it was emphasized by William A. M. Burden, special aviation assistant to the Secretary of

(Turn to page 86, please)

By James R. Custer



Flexible at Extreme Temperatures!

In the sub-zero cold of the stratosphere . . . often dropping to 70 or 80 degrees below zero . . . Permatex Aviation Form-A-Gasket does not become hard, crack or fly to pieces.

In the high temperatures of the desert . . . often reaching 140 or 150 degrees above zero . . . Permatex Aviation Form-A-Gasket does not melt or run.

Permatex Aviation Form-A-Gasket is a heavy liquid that flows smoothly from the brush and is easy to apply. It produces a non-drying, flexible seal that is leak-proof to fuels, lubricants and other liquids used in internal combustion engines. It disassembles very readily.

Used in the machines of war and in the machines of peace!



PERMATEX COMPANY, INC. Sheepshead Bay, N. Y., U. S. A.

New Production Equipment

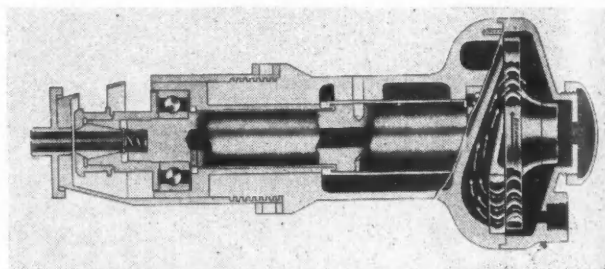
ONSRUD Air Turbine Motors, made by the Onsrud Machine Works, Chicago, Ill., have a patented rotor which is said to be exceptionally efficient. Operating on an impulse reaction principle, the solid milled rotor with bucket-type impeller blades, employs an air feed-back system to achieve high efficiency. The expanding air, plus patented Onsrud "Metered Mist" lubrication, hold unavoidable wear to a minimum in these motors.

Rotors of this type are used in air turbine motors built by Onsrud and the complete line includes motors ranging from 1/6 hp to 3 hp operating at speeds of from 15,000 rpm to 100,000 rpm. Although Onsrud developed these air turbines to power their own products, they are now making the full line available to manufacturers able to incorporate this type of motor in their product.

SNYDER TOOL AND ENGINEERING COMPANY, Detroit, Mich., has developed a special-purpose machine to expedite production in the counter-boring operation on the ends of aircraft piston wrist-pin holes.

Loading is manual, and the work is located by means of a pilot entering the piston. Center line of the wrist-pin holes is squared up by means of two manually operated locating fingers. The clamping mechanism is hydraulic and is regulated by means of electrically controlled valves. The

Sectional view of Onsrud Air Turbine Motor.



control buttons of the clamping mechanism are inoperative while the machine is in the work cycle.

Spindles are "Parker" precision with direct v-belt drive and are equipped with single-point tools, tungsten carbide tipped.

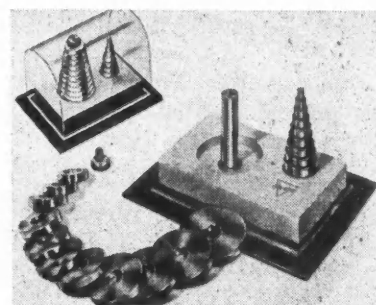
In the work cycle, tools make a rapid approach and feed to the required depth against solid stops, feed return for the depth of the counterbore and then rapidly retract to the rear of the slide to allow ample loading clearance. Two-way feed is employed to assure high quality finish on the work, without tool marks.

Coolant tank is in the rear of the machine and coolant is fed to the work through the fixture to the inside of the piston. All hydraulic equipment is housed in the base.

SAV-WAY INDUSTRIES, Detroit, Mich., have announced a set of master setting and checking rolls for the checking of micrometers and other

precision inspection and gaging instruments.

The set consists of 20 individual rolls ranging from .100 in. to 2.000 in. in diameter. The rolls are hardened, ground, and lapped to gage makers' X tolerance. They are deep frozen before finish grinding to eliminate internal strains and provide accelerated ageing.

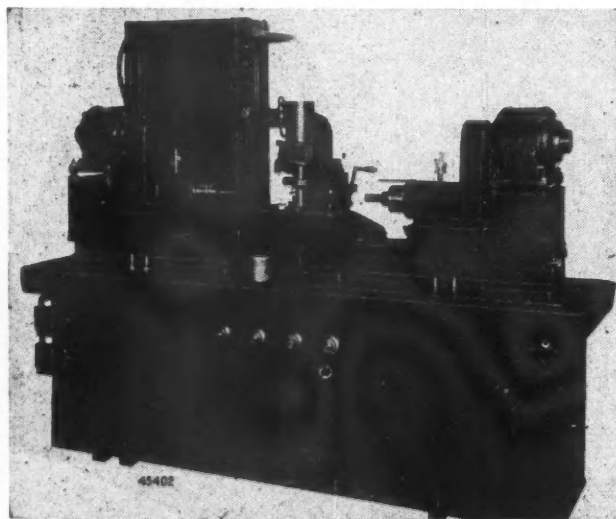


Sav-Way master setting and checking rolls.

When micrometer anvils have become unevenly worn by long use on one type of work, checking with flat gage blocks is not adequate, as only the high points of the anvils come in contact with the block. This method of checking will result in an inaccurate reading when the micrometer is subsequently used on round work.

Improper checks may also occur when a micrometer has had long use through one particular part of its range so that one section of the barrel is worn more than other sections. In this case, checking the micrometer through any one part of its range might show it accurate, while actually the instrument might be out considerably at the point of greatest wear. Sav-Way setting and checking rolls provide a means of making quick, accurate checks throughout the entire

(Turn to page 92, please)



Snyder two-way hydraulic machine



Another kind of "AIR COMBAT"

ON jeeps and tanks . . . on tank destroyers, half-tracs and trucks . . . by the hundreds of thousands, you'll find Hayes Automotive Cooling Fans doing a world-wide war job.

Born of peace-time leadership in this field—Hayes experience solves the unusual Diesel and gasoline engine cooling problems in combat vehicles.

Higher heat levels due to armor protection; higher air pressures due to bullet-proof grills and like devices; fan burdens created by vehicles moving at low speeds in difficult terrain with engines wide open—all must be met with aerodynamic efficiency that conserves maximum engine horsepower for motive power utilization.

For years, in the automobile and truck fields, this organization pioneered improved fan blade assembly design and function.



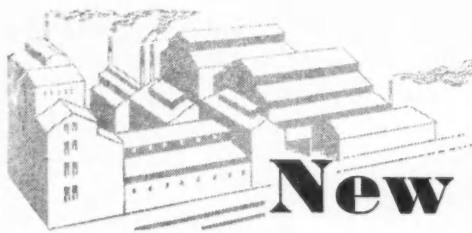
HAYES

**AUTOMOTIVE FANS
AIRCRAFT
WHEELS AND BRAKES**

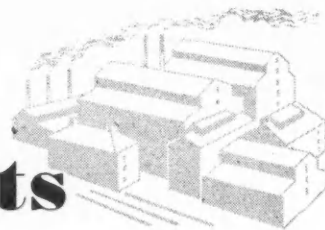
Representative: Airsupply Co., 5959 W. 3rd St., Los Angeles.

HAYES INDUSTRIES, INC.

Home Office: JACKSON, MICHIGAN, U. S. A.



New Products



"Compar," a New Name in Synthetic Plastics

A new name to add to the growing list of synthetic plastics is "compar"—a group of coal-limestone-and-air derivatives which might be called the missing link between plastics and synthetic rubber—notable for immunity to the new hard-to-handle aviation "super-fuels." The development of an almost endless chain of compar variations, which was announced by the Resistoflex Corporation, Belleville, N. J., grew out of the demand by warplane designers for a flexible material to handle toluol, xylol and benzol—which give the potent new U. S. super-gasolines their tremendous power but which quickly destroy most organic materials.

The compares are described by the manufacturer as "transparent, flexible, rubber-like plastic materials, five to twenty times more wear-resistant than natural rubber, and the most solvent-proof rubber-substitute yet developed." Some of the compares are already in use in warplane fuel and hydraulic hose, naval Diesel engines, chemical warfare equipment, in Sperry Gyropilots, and in the form of protective gloves, aprons and shoe-coatings for workers exposed to irritating petroleum solvents.

Synthetic Rubber Sponge

A general purpose synthetic rubber sponge has been placed on the market by The B. F. Goodrich Company, Akron, Ohio. It is made in three densities, soft, medium and firm grades. Each has good oil resisting properties, and can be made into slabs, cord, tubing, or in almost any other molded shape. The grades correspond pretty well with the pre-war crude rubber sponge.

Slabs 24 in. by 120 in. can be made in thicknesses of $\frac{1}{8}$, $\frac{3}{16}$, $\frac{1}{4}$, $\frac{5}{8}$ and $\frac{1}{2}$ in. and 24 in. by 60 in. slabs in the $\frac{3}{8}$ and one in. thicknesses.

Permag floor Cleaning Compound

Caked-on dirt, all traces of oil, grease and similar substances are quickly and effectively removed from floors when using Permag Compound No. 247-A, a product of the Magnuson Products Corporation, Brooklyn, N. Y. This specialized cleaner is used mixed with water and is said to have produced excellent results on concrete, wood, tile, and ordinary

wooden floors such as may be found in many factories.

Permag Compound No. 247-A also possesses disinfectant qualities and has a pleasant pine odor. When using Permag Compound No. 247-A the cleaning solution may be applied with either a mop or brush in the usual manner or be used in floor washing machines where this type of equipment is available.

Multi-Stage Power Unit for Gear Shifting

A newly developed multi-stage power unit for gear shifting applications is announced by Velvac, Inc., Detroit, Mich. This device is undergoing experimental tests at the present time. A diagrammatic layout of the Velvac "dual power-dual stroke" chamber, adaptable to modification for a specific installation on passenger cars or commercial vehicles, is shown here.

According to information supplied by the manufacturer, when moved in one direction, the chamber provides a high powered movement for disengagement and a continued lower powered movement (in the same direction) for engagement. The upper figure shows the position before the dual stroke starts and the lower figure shows the position when the dual stroke has been completed. From this completed position, the chamber will operate in the opposite direction with a high powered movement for disengagement and a continued lower powered movement for engagement.

The power transfer rod in the initial (high power) stage is moved the pre-determined distance by the large diaphragm bound by the outer shell. When this motion has been completed, the secondary power of the diaphragm bound by the inner moving shell comes

into play and the power transfer rod completes the second pre-determined movement at reduced power.

Power is developed by varying the fluid pressures on each side of the diaphragm through a suitable control valve. This differential pressure may be created by the vacuum from the manifold or air pressure from a compressor regulated by a dash or steering column mounted valve.

The manufacturer is prepared to modify the size, stroke, and power developed by this device in accordance with the needs of a specific installation.

Stop-Off Paint for Selective Carburization

"No-Kase," a stop-off paint for selective carburization on steel parts in liquid carburizing baths, has been developed by the Park Chemical Company of Detroit, Mich.

This new compound, the company states, provides positive protection from carburization on such difficult sections as threaded edges.

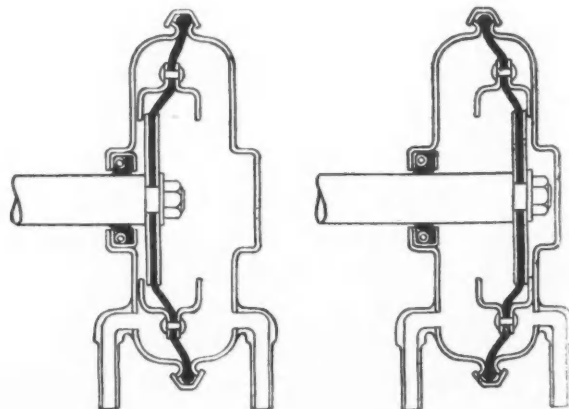
Applied as a paint, "No-Kase" is easily confined to the area where protection is desired and within an hour is sufficiently dry for immersion in the carburizing bath.

The heat of the bath burns out the vehicle of "No-Kase" paint and leaves the pigment as a continuous metallic coating. Any of the coating remaining after carburizing and quenching is easily removed by wire brushing. The compound is claimed to be the first successful stop-off paint yet developed for liquid carburizing.

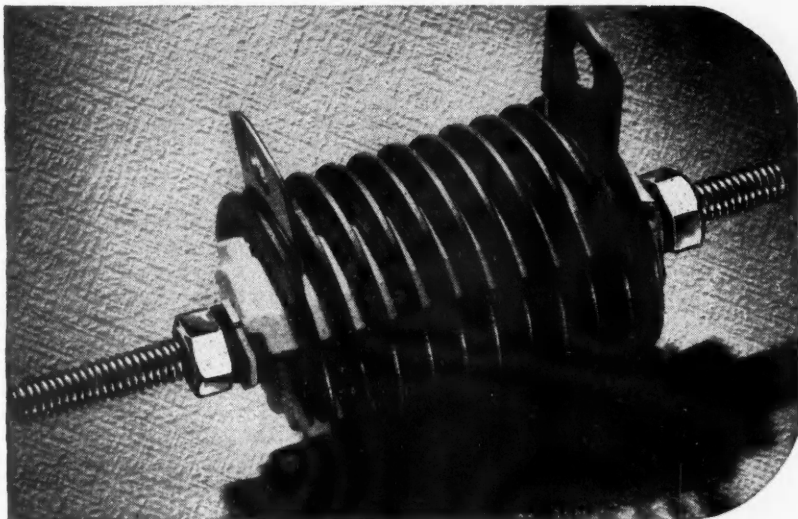
Skin Protector Made by Commercial Solvents

A new skin protector is being offered by the Commercial Solvents Corporation. (Turn to page 96, please)

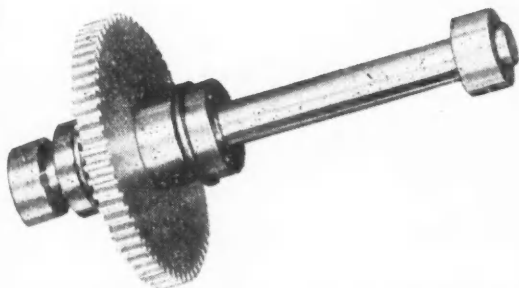
Velvac Multi-Stage Power Unit



This Stainless Strip is easy to bend — and is ideal for products like resistor units, where temperature changes must not affect the metal's electrical characteristics.



How you can take advantage of Carpenter's experience with Stainless Steel . . .



Constant uniformity from lot to lot — plus unusually close Stainless bar tolerances — helped one manufacturer turn this specialty war product into a mass production item.



Severe bending, forming and punching can be done faster when uniformly annealed Carpenter Stainless Strip is used for parts like this radio slide channel.

From your engineering department to final inspection floor, Carpenter can help you lick tough problems involving Stainless Steel.

In the shop, your nearby Carpenter representative can often offer suggestions to help you speed output, reduce rejects and cut scrap loss. He can provide useful information on fabricating operations and the properties provided by various types of Stainless.

And for cooperation in working out your product-design problems, get in touch with Carpenter's Metallurgical Department. Add our many years of experience with Stainless problems to your design-engineering knowledge — and together we can work out the solution.

Here are Fabricating Helps and Design-Engineering Data

Ask for your copy of this cross-indexed working data book. It is free to Stainless users in the U. S. A. and can really help you find quick answers to your questions about Stainless Steels for:

- ✓ **Special Corrosion Resistance**
- ✓ **Highest Tensile Strength**
- ✓ **Heat Resistance Properties**
- ✓ **Uniform Electrical Resistance**

This book also contains a helpful 24-page Fabricating Section, Glossary of Terms, Tables, etc. For your copy of "Working Data for Carpenter Stainless Steels", drop us a note on your company letterhead.



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STAINLESS STEELS

BRANCHES AT Chicago, Cleveland, Detroit, Hartford, St. Louis, Indianapolis, New York, Philadelphia

CIO Favors Elimination Of Little Steel Formula

Average Weekly Earnings in the Automotive Industry Reached a New High of \$58.47 in July

With the UAW-CIO in the van among proponents of the measure, the annual convention of the CIO in Philadelphia went on record as favoring the elimination of the Little Steel Formula and seeking wage adjustments in line with the increased cost of living because the administration has not rolled back prices to the level of Sept. 15, 1942. The resolution pointed out it is necessary to drop the Little Steel formula, which was intended to stabilize wages at the May, 1942, level, because wage earners must be permitted through collective bargaining to obtain adjustments at levels necessary to maintain morale, health and efficiency and to meet special needs imposed by the war. Philip Murray, CIO president, cited the need for making wage adjustments to eliminate inequalities and to establish wage patterns within industries on a national basis on the principle of equal pay for equal work.

In the automotive industry, average weekly earnings reached a new high of \$58.47 in July. This compares with average weekly earnings of \$19.80 and a work week of 33 hours in 1932, \$31.19 and 34 hours in 1939, \$39.59 and 38 hours in 1941, and \$50.72 and 44 hours in 1942, according to the AMA. The Bureau of Labor Statistics cost of living index went up 17 per cent between 1939 and 1942 while average weekly earnings rose 63 per cent over the same period. Average weekly earnings in the Michigan automobile industry in September were \$61.74 and average hourly earnings were \$1.33. This marks a 13 per cent increase in weekly earnings over the \$54.60 paid in September, 1942, even though wage rates supposedly are stabilized. Overtime accounts for some of the increase, the average work week being 43.7 hours in September, 1942, and 46.4 hours in the same month this year.

Demands of the UAW-CIO and other labor groups for further wage increases are challenged by A. T. Court, labor economist for General Motors, in the monthly publication of the Michigan Dept. of Labor Industry. Court asserts that weekly earnings of Michigan factory workers have increased 61 per cent since January, 1941, and hourly rates have risen 37 per cent

compared to a 25 per cent rise in the cost of living. The Little Steel Formula permits a 15 per cent wage increase up to May, 1942, to compensate for a 15 per cent increase in the cost of living between January, 1941, and May, '42. Court's computations show that average weekly Michigan earnings in 1939 were \$31.80 compared to Detroit cost-of-living of \$23.94 for a three-person family that year. Average weekly earnings for the first four months of 1943 were \$53.10, while the cost-of-living had advanced to \$30.05.

"How is it possible to reconcile the complaints about inadequate factory wages with the obvious flood of easy money," writes Court. "The average factory worker's income after taxes and savings shows that net spending money of the individual worker has gone up just a little more rapidly than the family cost of living in Detroit.

This means that the income of the average factory worker in Michigan has enabled him to maintain his personal standard of living completely unimpaired by any financial pressure, even after paying taxes and making the recommended 10 per cent saving."

Worker income also is increased by certain additional payments such as vacation pay. The WLB recently ordered an increased vacation pay schedule for 400,000 workers in General Motors plants. Employees with a year of company service as of July 1 were awarded 48 hours' pay instead of 40

(Turn to page 86, please)

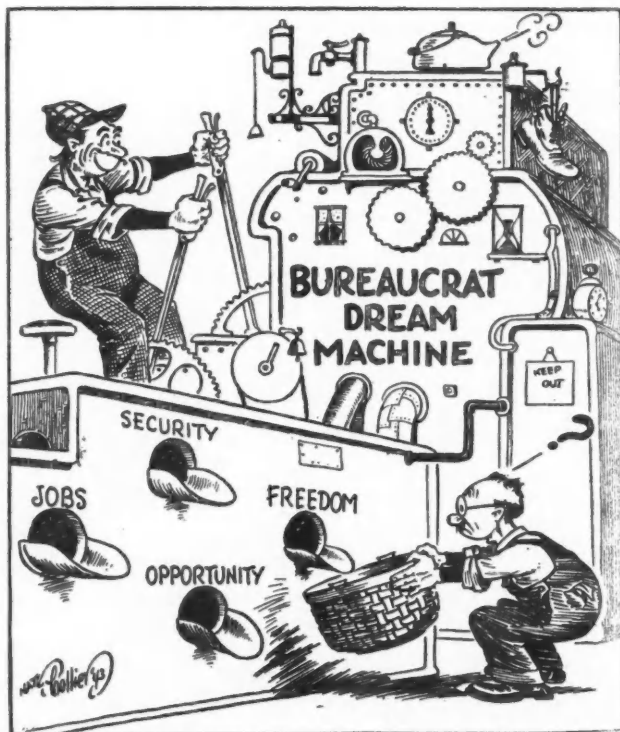
Plane and Motor Parts 1944 "Bottlenecks"

Ball bearings, gears, axle assemblies, and transmission assemblies will be the "bottlenecks" next year, according to some WPB officials. Increased demand for military trucks and amphibious landing equipment, replacement needs of domestic commercial vehicles, and expanded aircraft production are given as the principal factors that may cause a shortage of the vital parts and assemblies.

It Never Will Work

"I do not want to be taken care of by the government either directly or by any instruments through which the government is acting. I want only to have right and justice prevail so far as I am concerned. Give me right and justice and I will undertake to take care of myself. I will not live under trustees if I can help it. I do not care how wise, how patriotic, the trustees may be. I have never heard of any group of men in whose hands I am willing to lodge the liberties of America in trust."

Woodrow Wilson





SEA POWER, TOO, IS FIRE-POWER, MAN-POWER and HORSE-POWER



SCRAP METAL
IS NEEDED FOR
EVERY GUN,
TANK AND
SHIP. SEND
YOUR SCRAP
TO WAR.

What fearsome "wallops" are packed into those incredible P-T boats! The enemy has seen them sink his proudest warships and flash away in an impudent roar of magnificent American engine power!

All honor to American engineering, which created the P-T boat and our other engine-powered weapons of sea, sky and battlefield!

Making, by millions, the Sealed Power piston rings that safeguard such precious engine power, is our assignment in the war for liberty.

Our utmost care is exercised, to keep all Sealed Power products worthy of the great American-built engines in which they serve.

SEALED POWER CORPORATION

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PISTON RINGS — PISTONS — CYLINDER SLEEVES

Less Cadmium to Be Used for Plating by Aircraft Industry

Users of Small Amounts of Controlled Materials Will Receive Allotments on Annual Basis After Jan. 1, 1944

By W. C. Hirsch

Although more and more of the metal regulations, coming out of Washington, reflect easing of the supply situation, there comes ever so often a reminder that there are still critical

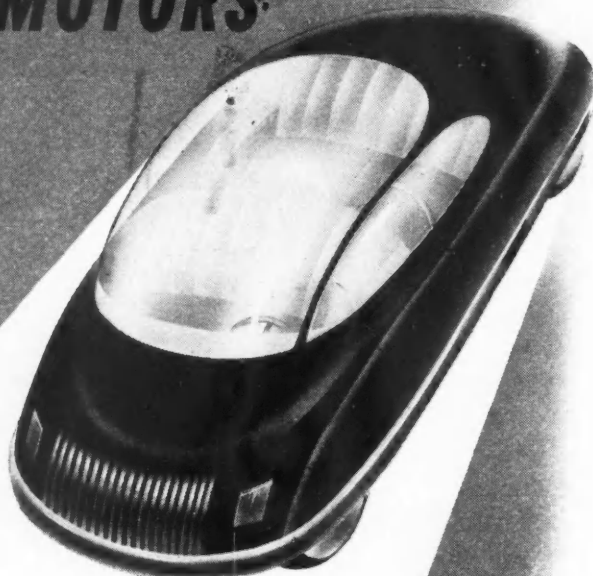
shortages to be overcome here and there. A directive recently issued by the Operating Committee on Aircraft Materials Conservation, dealing with the inadequate supply of cadmium, is a case in point. When a WPB survey

indicated that the supply of cadmium would not be sufficient to meet all future requirements, the aircraft industry, which uses approximately 50 per cent of all cadmium consumed, was directed to convert as quickly as possible from cadmium to zinc-plating, in whatever applications this was feasible. The outstanding use, in which cadmium is definitely superior to zinc, is when the plated part is subjected to extended salt spray contact or to intermittent submersion in salt water. Zinc-plating furnishes satisfactory protection against atmospheric exposure. The use of cadmium is permitted for plating those parts in which it is essential and forbidden in others in which zinc or other acceptable coatings will do. In this way, sufficient cadmium will be conserved to provide for those applications where its use is essential.

Perhaps most important among the developments that portend the letting down of restrictions, such as the paucity of the cadmium supply makes necessary, is the announcement by WPB that, effective January 1, 1944, users of less than 150 tons of carbon steel quarterly and of comparable tonnages of other controlled materials will receive allotments on an annual rather than a quarterly basis. It is expected that this will affect some 15,000 metal users, whose needs do not exceed 40 tons of alloy steels quarterly; 8,000 pounds of copper base alloy sheet and strip; 11,000 pounds of copper base alloy rod, bar and wire; 5,000 pounds of copper base alloy tubing and pipe; 11,000 pounds of brass mill unalloyed copper products; 15,000 pounds of wire mill copper products; 30,000 pounds of copper and copper base alloy foundry products; and 7,000 pounds of aluminum in all shapes. Eventually metal consumers in this class will have their allotments taken care of in WPB regional offices, this in line with the policy of decentralization that has been adopted by the Board. So far the search for open spaces on rolling mills' unfilled order books by those in need of sheet and strip steel hardly appears to be more successful than it has been right along. It is only in unusual cases that exception from the rule that alloy steels are to be produced in electric furnaces, so as to leave open-hearth capacity free for carbon steel production, is sanctioned, and as a result electric furnace output over the next few months is urgently needed for previous commitments.

The first scrap from European battlefields is reported to have arrived. Previous shipments from the war zone consisted largely of aviation scrap, some of it the result of accidents rather than battles. Latest arrivals consisted of material salvaged from the Mediterranean battlefields, including some Italian equipment of World War I origin. Among it was a cannon, made in 1916, that had burst under pressure. All this battle scrap is thoroughly examined to make sure that no explosives get into shipments.

ALWAYS A Controlling Factor ON MOTORS.



● In Summer or Winter . . . in war or peace . . . with new models or old models revised . . . we believe Dole Thermostats will continue to regulate motor temperatures for maximum operating efficiency—saving gas, oil and the motor.

THERMOSTATS and Leak-proof Primers

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What part will machine tools play in helping to feed this hungry belly?

Here stands a souvenir of War—a silent, implacable challenge to the meaning of our words . . . Here stands want.

A grim reminder that we must not waste food now—that we dare not complain—it also says, as no words could, that part of the victory we're fighting for can only be won with plowshares.

What part will machine tools play? The greatest part in history. For there is scarcely an essential to civilized living today that does not stem from a handful of basic precision machine tools . . . from the barest necessity, a loaf of bread, to the most intricate and wonderful machines which help men think, to search and to know.

And one of these machine tools—the internal grinding machine—is essential to the creation of literally everything that will make this world a better place in which to live, after this war is won.



BRYANT CHUCKING GRINDER COMPANY

SPRINGFIELD
VERMONT, U.S.A.

Martin to Build a New Plane Much Larger than the B-26 Marauder

Goal of 100,000 Planes This Year Probably Will Not Be Achieved. October Heavy Bomber Output Sets Record

Significant revision of the automotive industry's participation in the AAF bomber production program is indicated by the recent announcement by Glenn L. Martin that output of B-26 Marauders will be tapered off at the Omaha plant because Glenn L. Martin-

Nebraska Co. has been selected by the Army to build a new type war plane much larger than the B-26. However, production of Marauders will be continued at Martin's Baltimore factory. DeSoto Division of Chrysler Corp., Hudson Motor Car Co., Briggs Mfg. Co.

and Goodyear Aircraft Corp. have been supplying major airframe components of the B-26 for assembly at Omaha. With these contracts being terminated, it is not unlikely that the automotive plants will be given a part in production of the much larger plane that will be assembled at Omaha.

Gen. H. H. Arnold, chief of the AAF, said early this month that the final test of the Army's new super bomber, the B-29, "is not now far distant." He stated that the B-29 was as far ahead of the B-24 and the B-17 as they were beyond pre-war bombers. First experimental models of the B-29 were built at Seattle, where engineering of the design was handled by the staff of the Boeing Company, and the new plane was "evolved in secrecy during the past several years in close cooperation with the Army Air Forces and its material command."

"The new bomber will be powered with Wright engines and will use Hamilton Standard propellers," the General continued. "This battleship of the air is armored heavily with multiple gun and power turrets. It can fly at very high altitudes."

In a survey of U. S. aircraft some months ago, the British publication, "The Aeroplane," said, "Both (the Flying Fortress and the Lancaster) will be surpassed by the new Boeing B-29 and Consolidated B-32 bombers."

Reasons for cutbacks in the B-26 schedules were cited in the OWI report, which said, "Despite its high speed, good load capacity and excellent combat performance in several theaters, notably in New Guinea, the Mediterranean and Europe, the production of this plane (the Marauder) is being tapered off for four major reasons: Air Forces' policy is to reduce the number of models, concentrating production on highest performance types in a combat classification; the B-26's performance with one of its two motors shot out is not as good as a B-25's; it cannot be used out of smaller airports because of high landing and takeoff speed; and its maintenance is more difficult than the B-25's. Changing demands of tactical operations also entered into the decision to use trained Martin personnel and factory space for production of other more urgently required bomber types."

Revision of the automotive industry's part in the bomber program recalls that it was three years ago that Lieut.-Gen. W. S. Knudsen asked the industry to undertake \$500,000,000 in subcontracts on the original heavy bomber program. Since that time the industry has delivered \$4,000,000,000 worth of airframes, accessories and engines. Of that amount, \$3,000,000,000 has been delivered in the last 12 months and current shipments are at a rate of \$11,000,000 daily. Four plane types are being manufactured complete for flyaway delivery, the B-24 Liberator by Ford, the Grumman F-4-F Wildcat and TB-F Avenger by Eastern Aircraft Division of GM, and the Vought FG-1 Corsair

(Turn to page 84, please)

When...

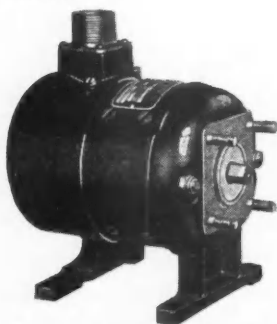
SHOULD THE MOTOR BE DISCUSSED IN DEVELOPING A NEW PRODUCT?

Here's our answer to that question, based on many years' experience: consider the special application motor problem in the *early* stages of product development!

Discussion of the motor before the product design has been completely worked out will frequently save time and money.

Perhaps our motor experience will be of value to your engineering department. We shall be very glad to work with them.

THE BLACK & DECKER ELECTRIC CO.
KENT OHIO



THOROUGH ENGINEERING is the basic factor behind the successful operation of this Feathering Pump motor and many other special application motors we have designed for all types of equipment.

Black & Decker

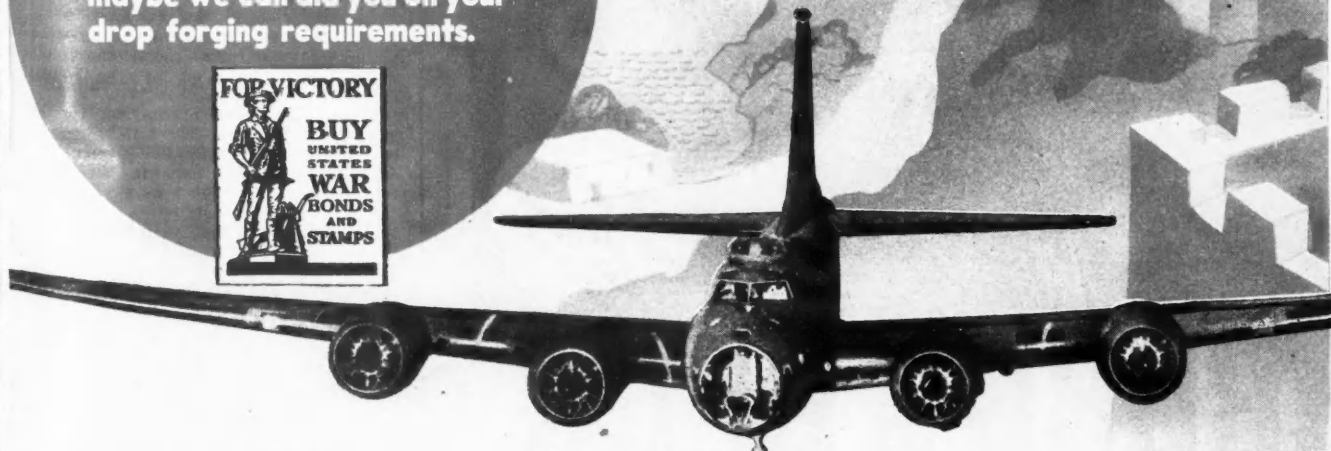
FRACTIONAL HORSEPOWER
SPECIAL APPLICATION **MOTORS**

They come back to go forth again

America's mighty new bombers not only blast each selected objective, despite heavy flak and hostile aircraft, but they throw a deadly fire in any direction, inexorably depleting enemy air power. And how they can take it! Even when bullet riddled and with several engines out, they return safely to their bases, soon to fly again.

In an ever increasing quantity, America's aircraft plants are releasing these rugged bombers. And twenty-four hours a day we are turning out super-tough drop forgings to give these planes greater ability to resist the stresses of flight and combat. The entire output of our large new, completely equipped drop forging plant is devoted to the production of airframe forgings — for engines, struts, wings, fuselage, bomb racks and other crucial plane parts.

We are serving many plane and engine builders now — maybe we can aid you on your drop forging requirements.



Member of the A.C.C.A.



Kropp Forge Aviation Co.

5301 W. ROOSEVELT ROAD

CHICAGO

Engineering Representatives in Principal Cities

David Beecroft

David Beecroft, 68, pioneer figure in the automotive industry publishing field and treasurer and past president of the Society of Automotive Engineers, died Nov. 5 at South Bend, Ind., in Epworth Hospital. He had been ill several months.

Mr. Beecroft began his automotive career in 1902 as editor of the *Automotive Review*. He was editor of *Motor Age* and later editorial director of *Motor Age*, *Motor World*, and *AUTOMOTIVE INDUSTRIES*. He left the editorial field in 1928 to become associated with the Bendix Corporation, prede-

cessor of the present Bendix Aviation Corporation.

Mr. Beecroft was associated with the Bendix organization throughout the intervening 15 years, serving in various executive capacities. At one time he was a member of the corporation's board of directors and assistant secretary.

He was active in the contests and road races which marked early development of the automobile. He drafted the first stock car racing rules and was long a member of the contest board of the American Automobile Association. In 1911 Mr. Beecroft joined the Society of Automotive Engineers, later served

as president and then treasurer of that organization. He was one of the founders of the Automobile Old Timers' Club, serving successively as director, vice-president and executive committee member. He also was among the founders of the Chicago Motor Club.

Throughout his many years of activity in the automotive industry he enjoyed the friendship of virtually every noteworthy figure connected with the development of the automobile from its earliest stages.

Mr. Beecroft was born July 17, 1875, in Huron county, Ontario, Canada. He is survived by a sister, Mrs. Henry McGee of Wingham, Ont.; and one brother, John Beecroft of Belgrave, Ont.

**SO
DEPENDABLE
When the Going
is TOUGH!**

BORG & BECK

The Standard Clutch in Peace or War!

For THAT VITAL SPOT where POWER TAKES HOLD OF THE LOAD!

BORG & BECK

The Standard Clutch in Peace or War!



BORG & BECK DIVISION

BORG-WARNER CORPORATION

CHICAGO, ILLINOIS

Business in Brief

*Written by the Guaranty Trust Co.,
New York, Exclusively for AUTO-
MOTIVE AND AVIATION INDUSTRIES*

Moderate expansion of general business activity is currently indicated. The seasonally adjusted index of *The New York Times* for the week ended Oct. 23 stands at 138.8, as against 137.8 for the preceding week and 131.7 a year ago.

Department store sales reported by the Federal Reserve Board for the week ended Oct. 23 were 12 per cent above the corresponding amount last year. For the period of four weeks then ended, the similar gain was 7 per cent; and sales in 1943 to date were 12 per cent greater than the comparable total a year ago.

Railway freight loadings during the week ended Oct. 23 totaled 905,319 cars, 0.8 per cent fewer than in the preceding week but 0.2 per cent above the corresponding number last year.

Electric power production increased more than seasonally in the same period and was 17.7 per cent larger than the output a year ago, as compared with a similar gain of 17.9 per cent registered a week earlier.

Crude oil production during the week ended Oct. 30 averaged 4,382,950 barrels daily, 26,800 barrels below the figure for the preceding week but 10,050 barrels more than the average recommended by the Petroleum Administration for War.

Bituminous coal production in the week ended Oct. 23 was officially estimated at 11,300,000 tons, as against 11,725,000 tons in the week before and 11,547,000 tons a year ago.

Engineering construction contracts awarded during the week ended Oct. 28 totaled \$31,985,000, according to *Engineering News-Record*, as compared with \$50,755,000 in the preceding week and \$103,282,000 in the corresponding period last year.

Professor Fisher's index of wholesale commodity prices for the week ended Oct. 29 stands at 111.1 per cent of the 1926 average, as compared with 111.3 a week earlier and 108.4 a year ago.

Member bank reserves increased \$3,000,000 during the week ended Oct. 27, and excess reserves declined \$350,000,000 to an estimated total of \$1,060,000,000. Business loans of reporting member banks increased \$63,000,000 in the same period but stood \$157,000,000 below the total a year earlier.

HIGHLIGHTS

Du Pont nylon

MILITARY APPLICATIONS FOR NYLON

Airplane motor part polishing brushes • Bristles for tooth and hair brushes used by armed forces • Flame actuators for airplane fire extinguisher systems • Gun-cleaning brush bristles • Catheters for armed forces • Screen-cleaning brush bristles for use in explosives manufacture • Sutures • Tapered paint brush bristles

ESSENTIAL CIVILIAN USES FOR NYLON

Bristles for bottle-washing brushes • Edging brushes • Electroplating brushes • Hose brushes • Hair brushes • Furnisher brushes • Labeling brushes • Sewage brushes • Shuttle tension brushes • Spotting brushes • Tenter brushes • Tooth brushes

FREE BOOKLETS ON DU PONT PLASTICS—for engineers, designers and production men—may be secured by writing on your business letterhead to: E. I. du Pont de Nemours & Co. (Inc.), Plastics Department, Arlington, New Jersey.

1. Pamphlet on nylon molding powder—complete information on uses, molding technique and properties of nylon molding powder.

2. Du Pont Plastics Bulletin—issued periodically, giving news of developments and applications of Du Pont Plastics.

3. Manual on "Lucite"—114 pages of facts, profusely illustrated, on the forming, fabricating and properties of "Lucite" methyl methacrylate resin.

4. Booklet on Heat-Resistant "Lucite"—contains factual information on Du Pont's amazing new heat-resistant "Lucite" formula.

5. Handbook on "Plastacel"—a comprehensive handbook on best methods of fabricating Du Pont's cellulose acetate sheets.



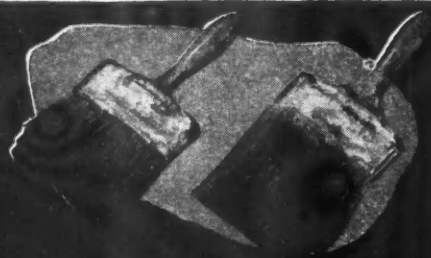
TYPICAL PROPERTIES OF FM-1 NYLON

PROPERTY	TEST RESULT	TEST METHOD
Specific gravity	1.14	ASTM D71-27
Tensile strength—70, 77, 170°F psi	16,620(1); 10,530; 9,290(2)	ASTM D638-42T
Elongation—70, 77, 170°F %	3%(1); 54%; 145%(2)	ASTM D638-42T
Modulus of elasticity 77°F psi	325,500	ASTM D638-42T
Flexural strength 77°F psi	12,600-14,600	ASTM D650-42T
Stiffness 77°F	1.89-2.02 (3)	Arlington M-9
Impact, Izod—70, 77, 170°F ft. lbs./in.	0.418; 0.944; 0.968	(8)D256-41T
Rockwell	100 L 65 M	Arlington M-29
Creep in flexure	89 (4)	Arlington P-25
Deformation under load 122°F %	4.0	ASTM D621-41T
Heat distortion temperature °F	149	ASTM D648-41T
Heat distortion temperature—low load °F	403 (5)	ASTM D648-41T
Specific heat cal/gm/°C	0.55	
Coefficient of expansion per. °F	5.7 x 10 ⁻⁵	ASTM D696-42T
Thermal conductivity—Btu/hr/ft ² /°F/in.	1.74	ASTM D325-31T
Dielectric strength, short time—V/M	400	ASTM D149-39T
Dielectric strength, step by step—V/M	300	ASTM D149-39T
Volume resistivity ohm-cm.	10 ¹³	ASTM D257-38
Dielectric constant, 60, 10 ⁶ cycles	3.8 (6); 4 (7)	ASTM D150-41T
Power factor, 60, 10 ⁶ cycles	1.8 (6); 5 (7)	ASTM D150-41T
Water absorption %	1.5	ASTM D570-42
Flammability in./min.	Self extinguishing	ASTM D635-41T
Methods of working	Injection, compression, extrusion	
Basic color	Light cream	
Resistant to	Esters, ketones, alkalies, alcohols, common solvents, weak acids	
Not resistant to	Phenol, formic acid, conc. mineral acids	
Outstanding for	Toughness, high temp. resistance	
Major uses	Heat resistant parts	

(THE NUMBERS IN PARENTHESES IN THE DATA REFER SPECIFICALLY TO DEVIATIONS FROM ACCEPTED TEST METHODS)

- (1) —58°F
- (2) 140°F
- (3) Millimeters deflection at .125" thickness
- (4) Mils. after 48 hours at 1600 psi and 77°F, minus original deflection
- (5) 64 psi — D 648-41 T mod.
- (6) 33°C dry
- (7) 22°C, 18% RH, 10⁶ cycles
- (8) Type R conditioning

Nylon monofilaments meet Bureau of Ships ad interim Specification 38B42 for paint brush bristles.



Nylon paint bristles wear at least 3 times as long as top-quality hog bristles. Brush above, left, made with natural bristles, covered 23,000 feet of brick and concrete. Brush at right, made with nylon, covered the same area, but retained strength and life!

DU PONT PLASTICS

Better Things for Better Living
... Through Chemistry

Obituary

Rowland Campbell, 48, one-time board chairman and president of the Reo Motor Car Co., died Oct. 19 at his home in Appleton, Wis.

W. B. Jarvis, 76, board chairman and vice-president of the W. B. Jarvis Co., Grand Rapids, died Oct. 26 at his winter home in Palm Beach, Fla.

Graham Bethune Grosvenor, 59, a director of Pan American Airways, Inc., a member of the executive committee and special assistant to Pan American's President Juan T. Trippe, died Oct. 28 at New York.

Charles Wescott Gennett, Jr., 67, vice-president of Sperry Rail Service, a division of Sperry Products, Inc., Hoboken, N. J., died Oct. 26 at his home in Chicago.

Noble C. Banks, 71, board chairman and former president of Gear Grinding Machine Co., Detroit, died Oct. 30 at Palm Springs, Cal., after a long illness. He joined Gear Grinding Machine Co. in 1909 and later was elected president. Except for a short interim as organizer of an English branch, he was president until 1937, when he retired. He was succeeded as president by his son-in-law, Chisholm N. Macdonald.

Caleb S. Bragg

Caleb Bragg, 57, airplane and automobile racer, and a director of the Wright Aeronautical Corp., died October 24 at New York, N. Y. Until his retirement last March, he was vice-president of the C. M. Keyes Aircraft Service.

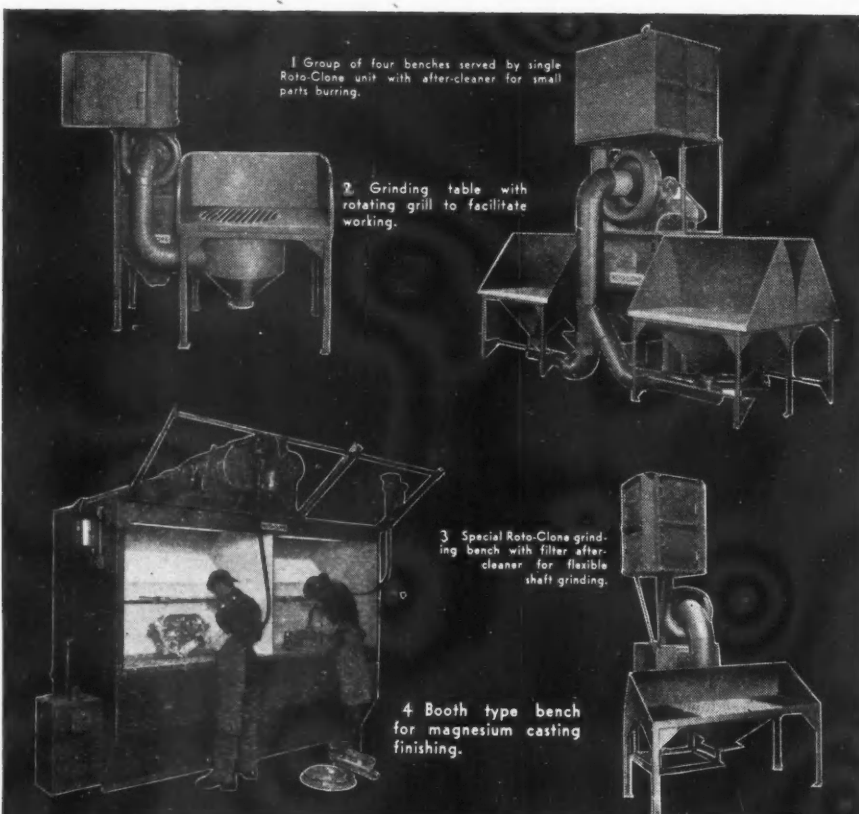
Mr. Bragg became associated with Glenn Martin in 1915, and became vice-president of the Glenn L. Martin Company the same year. The following year he assisted in the organization of the Wright-Martin Company, which became the Wright Aeronautical Corporation. In 1919 Mr. Bragg organized the Bragg-Kleisrath Corporation and became its president. The Bendix Aviation Corporation acquired the Bragg-Kleisrath Corporation in 1930, at which time Mr. Bragg became vice-president of the former corporation. He retired from business in 1931, but returned in 1935 as vice-president of the Bendix Marine Products Corporation.

Film Illustrates Processing Methods

The Dow Chemical Company has recently prepared and released a technical film describing processing methods for magnesium alloys.

The film deals with the machining, welding, forming, riveting and surface treating of magnesium, and is available for showing before engineering, industrial and technical society groups.

Requests for the film or for information regarding it should be directed to the Dow Chemical Company, Midland, Mich.



ROTO-CLONE

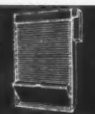
Dust Control

GRINDING BENCHES SPEED PRODUCTION

Shown on this page are some of the special AAF Roto-Clone grinding benches designed to meet specific needs in war production plants. Complete information on each will be sent on request.

AMERICAN AIR FILTER COMPANY, INC., 449 Central Avenue, Louisville, Ky.

In Canada: Darling Bros., Ltd., Montreal, P. Q.



SELF-CLEANING AIR FILTER

DRY FILTER

DUST ARRESTER

ELECTRIC PRECIPITATOR

ROTO-CLONE PRECIPITATOR



Awards

Names and winners of Army-Navy "E" awards in or allied with the automotive and aviation industries, announced since the Nov. 1 issue of *Automotive and Aviation Industries* went to press.

AVEY DRILLING MACHINE CO., Covington, Ky.

BAKEWELL AIRCRAFT PRODUCTS CO., Los Angeles, Cal.

BINKS MANUFACTURING CO., Chicago, Ill.

BUFFALO BOLT CO., North Tonawanda, N. Y.

H. D. CONKEY AND CO., Conco Eng. Wks., Mendota, Ill.

COOK ELECTRIC CO., Chicago, Ill.

ERIE RESISTOR CORPORATION, Erie, Pa.

RADIO CONDENSER CO., Camden, N. J.

WILEY MACHINE CO., Los Angeles, Cal.

Pontiac Motor Division of GM has been awarded a third Navy star for continued high production.

"R" --- "KR"

...know what they stand for

Special Monels with Superior Machining Properties

The strength and corrosion resistance of Monel are so well known that they require no comment.

But do you realize that in addition to *regular* Monel, there are two *special* Monels—"R" Monel and "KR" Monel?

"R" Monel... When introduced several years ago, "R" Monel made available the properties of Monel coupled with improved machinability.

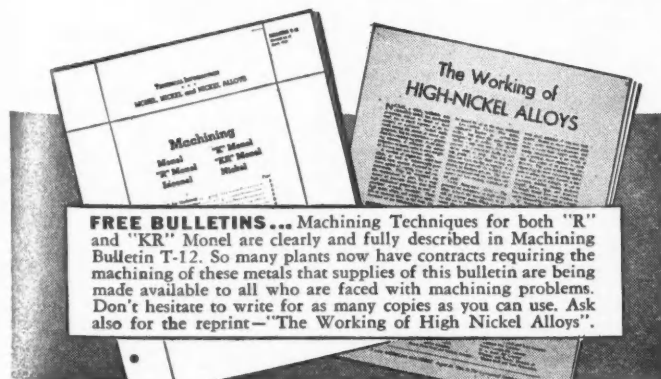
"R" Monel is readily fabricated by cold forming—is produced as hot-rolled and cold-drawn rounds, squares and hexagons. It is ideally suited for the automatic production of rust-proof screw machine parts, yet has mechanical properties equal to steel screw stock (S.A.E. 1112), and is actually tougher.

"R" Monel is NOT heat-treatable. (See "KR" Monel below.)

"KR" Monel... The newest member of the Monel family, "KR" Monel, offers machining qualities you wouldn't expect to find in a metal with so many other superior properties—corrosion resistance combined with non-magnetic characteristics, plus exceptional hardness and strength that can result only from heat treatment.

"KR" should be used for screw machine products which are to be heat treated after machining. Remember "KR" Monel as the MACHINABLE brother of "K" Monel, long known for its great strength and hardness. The International Nickel Company, Inc., 67 Wall Street, New York, N. Y.

★ **SAVE MACHINING TIME AND MONEY... Specify "R" Monel and "KR" Monel**



FREE BULLETINS... Machining Techniques for both "R" and "KR" Monel are clearly and fully described in Machining Bulletin T-12. So many plants now have contracts requiring the machining of these metals that supplies of this bulletin are being made available to all who are faced with machining problems. Don't hesitate to write for as many copies as you can use. Ask also for the reprint—"The Working of High Nickel Alloys".

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York, N. Y.

Gentlemen: Please send me copy of your Machining Bulletin T-12 and also the reprint "The Working of High Nickel Alloys."

NAME _____

COMPANY _____

TITLE _____

ADDRESS _____

A. & A. I. 11-15-43

PERSONALS

Daniel C. Tetor, a director and general factory manager of The Perfect Circle Co., has been elected a vice-president of the company.

Micromatic Hone Corp. has announced the following personnel changes. **Lawrence S. Martz** has been named assistant to the president; **Gerald Carlisle** is controller and assistant treasurer and **Don S. Connor** has been appointed director of the field engineering.

Arens Controls, Inc., has announced the appointment of **Philip Hooker** as sales and advertising manager. He was formerly

with Bell Aircraft Corp. Announcement has also been made of the appointment of **Bert Borchardt** as manager of the West Coast Branch of Arens, in charge of all contact operations in that territory.

James C. Kellogg has returned to the presidency of the Kellogg Switchboard and Supply Co., after four years of retirement. He succeeds **Major Maurice K. McGrath**, who has resigned as president, but will continue as a director.

International Nickel Co. has announced that **Reuel E. Warriner**, until recently associated with the Tank Automotive Center of the Army Ordnance Dept., has resumed duties with the company as supervisor of the movement of nickel required to meet demands of the steel industry.

Stephen B. Mambert has been made assistant to **Alfred Marchev**, president of Republic Aviation Corp.

J. Arthur Minch has been made vice-president in charge of operations of the Electric Auto-Lite Company's battery division.

J. N. Bayne, vice-president of Mack-International Motor Truck Corp., has arrived in Australia where he will act as consultant on motor trucks to the Australian government.

Paul R. Jordan, general manager of Harvill Corp., was elected vice-president and general manager of the company.

The Briggs Clarifier Co. has appointed **Henry T. Moore** general sales manager, and **E. K. Burgess** and **J. H. Nash** assistant sales managers of the newly organized automotive and industrial divisions, respectively.

W. F. Newbery has been made sales manager of the Industrial Div. of Detrex (formerly Detroit Rex Products Co.) Corp. Titeflex Metal Hose Co. has announced the appointment of **John Dunn** as works manager in charge of all plants of the company. He is succeeded as production manager by **Arthur F. Pennington**.

Houde Engineering Div. of Houdaille-Hershey Corp., has announced the appointment of **A. C. Ryan** as director of sales. He was formerly with the Detroit regional staff of the WPB.

The Board of Directors of Vanadium-Alloys Steel Co. have elected **Roy McKenna** chairman of the board; **Floyd Rose**, president, and **James P. Gill**, vice-president of the company.

Luther H. Atkinson has been appointed vice-president in charge of sales of the Elastic Stop Nut Corp. He was formerly associated with the Weyerhaeuser Sales Co. of St. Paul.

Lt. Frank Kafer, of the Goodyear Tire & Rubber Company Highway Transportation dept., will leave for Calcutta, India, where he will become sales manager of the Goodyear Tire & Rubber Co. (India).

Lawrence H. Cooper, former director of field operations of Consolidated Vultee Aircraft Corp. at San Diego, has been made manager of the Elizabeth City, N. C., Div.

Erwin Eble has joined the public relations department of The General Tire & Rubber Co.

Charles B. Konselman has been made advertising manager of Wickwire Spencer Steel Co.

Westinghouse Electric & Mfg. Co. has announced the appointment of **Ralph E. Kruck** as manager of the product design dept. of the company.

Reuben H. Fleet, of San Diego, was elected president of the Institute of the Aeronautical Sciences for the year 1944. Major Fleet will succeed **Dr. Hugh L. Dryden** of the National Bureau of Standards.

Kennametal, Inc., has announced the appointment of **John C. Redmond** as research engineer and chief analytical chemist.

Colonel Edwin W. Rawlings has been named administrator of the Aircraft Scheduling Unit, located at Wright Field. He was formerly chief of the Resources Control Section of the Materiel Command.

Paul A. Scherer, research engineer, has been made chief of the Engineering and Transition Office of the National Defense Research Committee.

Joseph T. Hartson, executive vice-president of Glenn L. Martin Co., has been elected president of Glenn L. Martin-Nebraska Co., Omaha, succeeding **Glenn L. Martin**, who resigned to devote himself to other assignments.

Charles R. Jenkins, formerly merchandising executive of Montgomery-Ward Co., has been named manager of car and home merchandise in the retail stores division of Goodyear Tire & Rubber Co.

William L. Wilson, formerly director of industrial relations at the Farmingdale, L. I., plant of Republic Aircraft Corp., has been appointed assistant to the president of Kellett Aircraft Corp. **Morgan C. Monroe** has been named to succeed **Wilson** at Republic Aircraft Corp.

Named by Gov. **Harry F. Kelly** to the



SEND FOR FREE SAMPLE

This
**ONE LENGTH
CLAMP
WILL MAKE
ALL THESE
CLAMP SIZES**

**Central
UNIVERSAL CLAMPS**

Are Used In Production and
Service of

Army and Navy
Trucks, Tanks,
Jeeps, Aircraft,
Half-Tracks, Am-
phibians, Cranes,
Marine Engines,
Road Rollers, Farm
Machinery, Port-
able Saws, Search-
lights, All Types
of Radiator Hose,
Diesel and Gas-
oline Motors.

**... AND HUNDREDS
OF OTHER SIZES**

This powerful, self-locking clamp is absolutely perfect for all hose connections. Easiest to use! Has maximum take-up. Comes packed flat in any length to fit any desired range of diameter sizes.

CENTRAL EQUIPMENT CO.
1018 So. Wabash Avenue Chicago 5, Ill.

Fastest Thing in Fastenings!



**REDUCE
NET WEIGHT**

**RESIST
VIBRATION LOOSENING**

Speed Nuts

CONSERVE WAR MANPOWER

SPEED NUTS have become industry's universal fasteners because:

1. They do not shake loose with vibration.
2. They reduce weight and conserve critical metal.
3. They are applied faster and conserve war manpower.
4. They lower net assembly costs.

Month after month, tons of critical material and countless man hours assembly time are being saved by conversion to spring steel SPEED NUTS. The faster this conversion is expanded the quicker SPEED NUTS will pay you even bigger dividends. In writing for samples, kindly give engineering details to expedite quick selection of SPEED NUT adapted to your needs.

TINNERMAN PRODUCTS, INC. • 2059 Fulton Road, Cleveland, Ohio

In Canada: Wallace Barnes Co., Ltd., Hamilton, Ontario

In England: Simmonds Aerocessories, Ltd., London

New Permanent Mold Foundry for Sterling

The new permanent mold foundry of Sterling Aluminum Products, Inc., of St. Louis is under construction at this time. Occupancy is anticipated January, 1944.

In order to incorporate all desired building features for the most modern methods of casting, heat treating and machining permanent mold aluminum alloy pistons, all architectural data was developed by the firm's own engineering department.

The building is a single story struc-

ture with dimensions of 300 feet by 140 feet. The construction is of gray brick and stone with a glass brick center front for executive offices. An open air inner court will provide employee recreational facilities.

Sun Aviation Fuel Concentrate

Development of Dynafuel, a super aviation fuel concentrate made entirely from petroleum and especially processed in order to produce the greatest possible power, was announced by J. Howard Pew, President of Sun Oil Company.

Mr. Pew stated that this new super aviation fuel concentrate is 50 per cent more powerful than United States standard 100-octane test fuel. Dynafuel is the product of a process devised by Sun Oil Company engineers, the details of which cannot be revealed at this time.

Dynafuel is never used undiluted but is blended with gasoline produced by other methods in order to step up their quality as aviation fuel. Thus Dynafuel makes possible the production of greater quantities of aviation fuel made to highest military specifications.

New Name for Rohm & Haas Molding Powders

Rohm & Haas Company, manufacturers of Plexiglas acrylic resin sheets and rods, announced that their molding materials formerly known as Crystalite, will henceforth be called "Plexiglas Molding Powders." Because the name plexiglas has become well known through its use on aircraft for transparent streamlined bomber noses, turrets and domes, and since the molding powders are made from the same basic raw materials, the change is being made in the interests of clarity and simplification.

Allegheny Ludlum Carbide Division

The Allegheny Ludlum Steel Corporation, Brackenridge, Pa., has acquired the Carbide Alloy Corporation of New York City. The property will henceforth be operated as Allegheny Ludlum's Carbide Division.

Niles Expands into Aviation Field

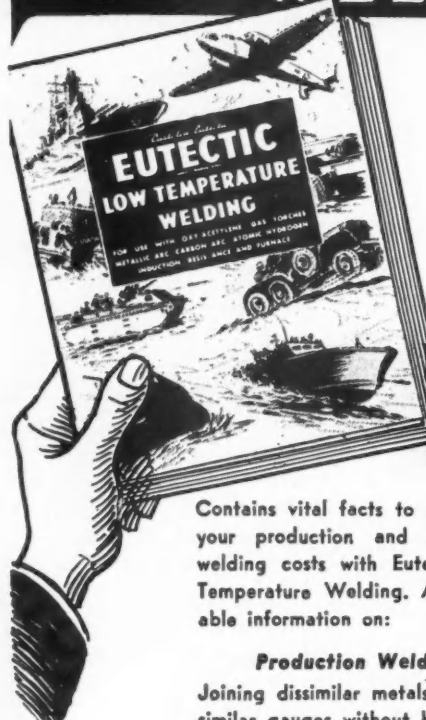
Niles-Bement-Pond Company of West Hartford, Conn., has acquired the Chandler-Evans Corporation of South Meriden, Conn., through an exchange of Niles Treasury stock for the entire stock of the Chandler-Evans Corp. The Chandler-Evans plants at South Meriden, Wallingford and Dayton, Ohio, will continue to operate as at present, under the same management and with the same personnel. Charles W. Deeds will continue as President of the subsidiary company, and no changes are anticipated.

Castolin Eutectic

EUTECTIC*

(Means Lowest Binding Alloy)

LOW TEMPERATURE WELDING



FREE LATEST

WELDING

DATA BOOK

Contains the Answers to Hundreds of Wartime Welding Problems

Contains vital facts to speed up your production and cut your welding costs with Eutectic Low Temperature Welding. Also valuable information on:

Production Welding

Joining dissimilar metals and dissimilar gauges without burning • Design simplification • Substitution of butt joints for lap joints, etc.

Salvaging Defective Castings

Effectively at low cost • Completely machinable, invisible welds • Ideal for thin walled or heavy castings in all metals.

Maintenance Welding and Tool Salvaging

"Hard-to-get" tools costing up to \$180 and requiring up to 50 weeks for delivery, salvaged for re-use in a few minutes at a cost of but a few cents.

Ordinance Plant Engineer writes: "Book very instructive, send ten more for distribution."
Write for Welding Data Book H

See our Exhibit at the
19th Exposition of Chemical Industries
BOOTH No. 403
Madison Square Garden, N. Y. Dec. 6-11
*Reg. U. S. Pat. Off.

EUTECTIC
WELDING ALLOYS COMPANY
Originators of the Low Temperature Welding Process
40 WORTH STREET, NEW YORK, 13, N. Y.

EUTECTIC WELDING ALLOYS COMPANY
40 WORTH ST., N. Y. 13, N. Y.

Please send your latest Welding Data Book H

Name

Company

Address City

CALENDAR

Conventions and Meetings

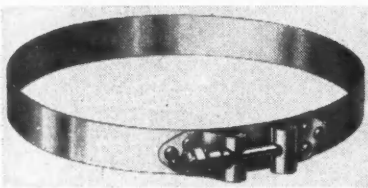
Highway Research Board, Annual Meeting, Chicago	Nov. 27-30
Natl. Aviation Training Assoc., St. Louis—Convention	Dec. 2-4
SAE Annual Mtg. & Eng. Display, Detroit	Jan. 10-14
Institute of the Aeronautical Sciences—Annual Meeting—New York City	Jan. 25-27

New Products for Aircraft

Aluminum Alloy Clamp

An aluminum alloy clamp, combining strength with extremely light weight, is being offered by Marman Products Company, Inc., Inglewood, Cal.

Marman's design, which wraps the ends of the band over a circular cross bar anchor at each attachment to the adjustment mechanism, requires no severe forming of the material and is therefore particularly adapted to the use of these light alloys. This feature is said to result in a clamp assembly wherein all loads are evenly distributed and no stress concentrations are produced.

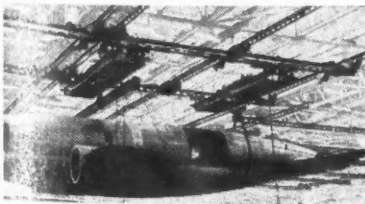


Marman aluminum alloy clamp

The maker states that these light weight clamps are particularly suited for use in ventilation, carburetor intake, supercharger, intercooler and similar installations where medium and large sizes are required and maximum weight savings can be realized.

Tramrail Transfer Bridge System

The Cleveland Crane & Engineering Co., Wickliffe, Ohio, has designed and built a 10-ton Cleveland Tramrail transfer bridge system for handling planes, such as C-46 Curtiss Commando air transports, at the Curtiss-Wright Corporation. The various



10-ton Cleveland Tramrail transfer bridge system

fuselage sections, wings, engines, and other parts are brought together by means of the bridges which may be interlocked, enabling the transfer of

loads from one bridge to another. The transfer bridges, which are completely motorized, are controlled from the floor by means of pendant push-button stations.

Malabar Tail and Axle Jack for Airplanes

This hydraulic jack which offers many height and lift combinations is

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- 6 JOGGLES & OFFSETS
- 7 CUTS ODD SHAPES
- 8 BEVELS OF ANY ANGLE
- 9 CUTS REVERSE CURVES
- 10 BEADS & U'S

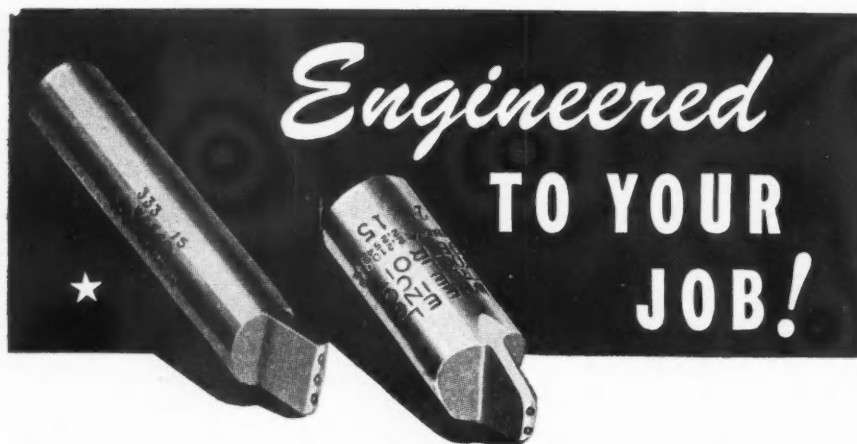
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Malabar tail and axle jack



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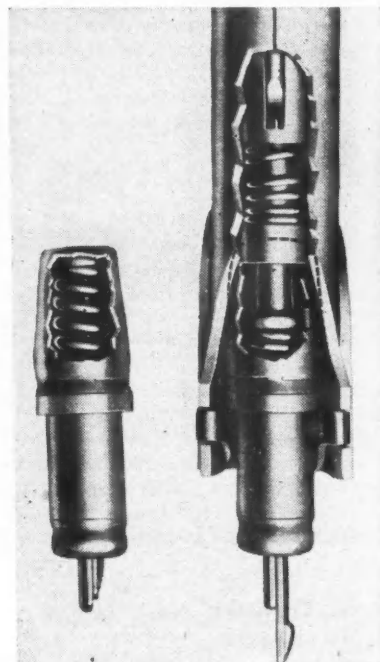
Detroit 6, Mich.

Two new safety developments designed to cut the accident hazard in the use of airplane skin fasteners are announced by the Prestole Division, Toledo, Ohio, of the Detroit Harvester Co.

The first development is the addition of a cap to the conventional fastener, the cap preventing retrograde movement of the spring and fastening element in the event of failure and so eliminating the hazard of flying parts.

The second development is a redesign of the company's Prestite Safety Gun so that the plunger which actuates the fastener extends within the cup, thereby eliminating the possibility of the fastener shooting out of the gun or becoming disengaged due to the improper placing of the fastener in the inserting tool.

Both improvements were evolved.



Airplane skin fastener with cap, and improved Prestite Safety Gun

the company stated, in answer to requests from users for equipment which would reduce the rate of industrial accidents caused in part by the extreme spring pressure required of these fasteners in clamping sheets tightly together, and by the fact that previous assembly tool design allowed the fastener, if not properly placed, to shoot out of the tool at the risk of the operator and nearby workmen.

Back the Attack with War Bonds

"A Welding Technique" he said

★ ★ ★ ★ *"with speed unequalled
in the history of merchant shipping"*

...and this, Mr. Prime Minister, is what he meant:



SHOP FABRICATION. Ships welded on a production line by assembly line methods—faster welding by positioning the welding—pre-fabrication of large sections—upside-down assembly—dozens of shortcuts make up this technique, recourse to which has revolutionized shipbuilding.

MASS PRODUCTION. If ships can be put on a mass production basis, think of the speed and economy in producing products less bulky. If speed alone were the only benefit of welding, recourse to it might be debatable. But consider these additional benefits:

LESS STEEL

On these 200 ships, recourse to arc welding saves 375,600 tons. Steel is critical. Steel costs money.

LESS HULL FRICTION

A welded Liberty ship leaving New York would reach Sicily 40 hours quicker than its rough-skinned sister of equal horsepower.

INCREASED CARGO

18% more cargo carrying capacity is provided by weight-cutting through recourse to arc welding.

15 to 20 Ships a Month

In order that the general understanding we reached, during the early days of our engagement together in this war, may be more perfectly carried out, and in order as a practical matter to avoid the prodigal use of manpower and shipping that would result from pursuing any other course, I am directing the War Shipping Administration, under appropriate bareboat arrangements, to number to your flag for temporary wartime duty during each of the suggested next ten months a minimum of fifteen ships.

I have furthermore suggested to them that this be increased to twenty.

We have been allocating to British services on a voyage-to-voyage basis large numbers of American-controlled ships. What I am now suggesting to you, and what I am directing the War Shipping Administration to carry out, will be in the nature of a substitution to the extent of tonnage transferred for the American tonnage that has usually been employed in your war program.

Details of the arrangements we can properly leave to national shipping authorities for settlement through the Combined Shipping Adjustment Board, whose function it is to concert employment of all merchant vessels, and will in accordance with its usual practice do so in connection with these particular ships.

Always sincerely,
FRANKLIN D. ROOSEVELT.

America's greatest natural recourse
ARC WELDING

New Method Developed for Removing Broken Taps and Drills

THE Elox method, which was developed recently at the Modern Methods Experimental Co. in Detroit for salvaging machined parts which have been rejected due to broken taps, reamers or drills bedded in holes, is now being used on a commercial scale for that purpose and it apparently has possibili-

ties for the salvaging of used parts in military maintenance shops as well as in garages and repair shops for civilian equipment. Experience to date also points to the potentialities of the Elox method in certain production operations. For example, it is possible to drill oil holes in hardened pieces such

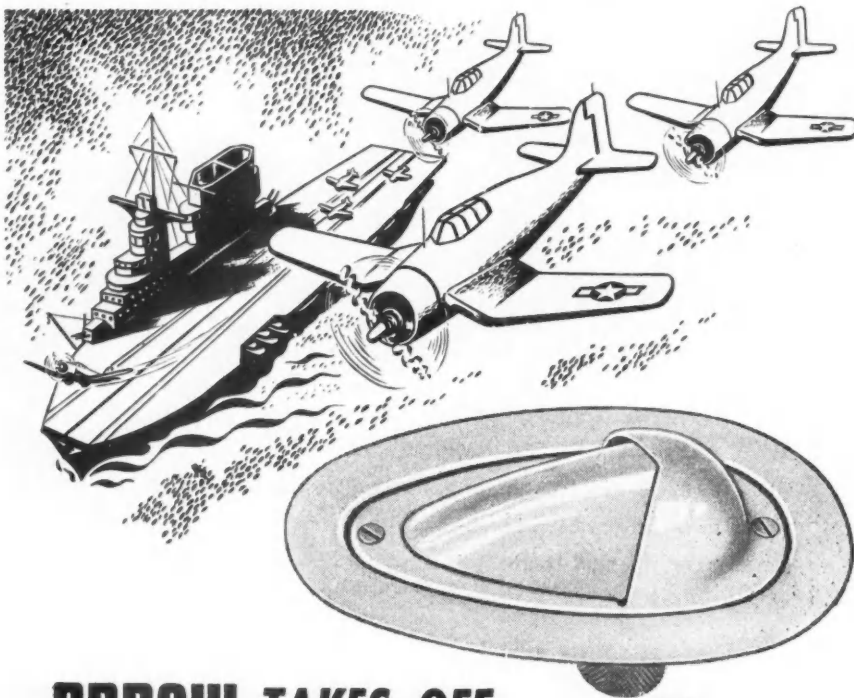
as aircraft engine crankshafts; it is feasible to assemble gears or collars on shafts after heat treatment of all parts, lining up the assembly to a simple gage and then drilling through for a suitable fastening. It is claimed, too, that by the development of a properly-shaped tool it should be possible to produce square, oval, or specially shaped holes in hardened dies without annealing. The equipment consists essentially of the following elements:

1. A disintegrator head, comprising a special solenoid, and carrying the cutting tool.
2. A transformer of special design to reduce line voltage to the low voltage and high current density required for the process.
3. A source of water supply, either a city tap or pump.

The equipment is set up on a drill press or any other machine shop tool having a sufficiently deep throat to clear the work, and a means for feeding the disintegrating head into the work. The operation is quite the same as the drilling of a hole, the tool being a specially-formed drawn copper tube with a fine hole through the center to conduct a stream of water into the hole.

The mechanism of disintegration is believed to be about as follows: when the tool or electrode makes contact with the work, an electrical circuit is completed, permitting the passage of a heavy current which creates a hot spot on the metal. During this process a stream of water flows continuously through the cutting tip, cooling both the tool and the work. As the hot spots are created, the solenoid operates the electrode, which is raised to momentarily break the contact. This cycle of events causes an arc to form between the top of the tool and the point of contact. Apparently the arc breaks down some of the water, releasing oxygen which is absorbed by the hot metal, producing an accelerated and intensified oxidation of the metal, disintegrating it immediately. At the same time the simple phenomena of expansion and sudden contraction due to the stream of water cause larger portions of metal than those actually oxidized to break off. All of these broken-off particles are washed out of the hole by the pressure of the stream of water.

The process occurs so rapidly that no annealing takes place in the base material in which the broken tap or drill is bedded. From the standpoint of safety, it is claimed that a fine balance of resistance, reactance, and reluctance can be achieved through proper design, eliminating all hazard of short circuiting of the apparatus.



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Precision Machined Engine Parts

(Continued from page 29)

is found in the set-up on a two-spindle Ex-Cell-O boring machine in which a combination tool is used for machining the radius and breaking edges in one setting. The large face is rough ground in a 16-A2 Blanchard surface grinder, the non-magnetic work being held on the magnetic chuck between steel blocks. Final operations are rough- and finish-grinding of the OD in Cincinnati centerless grinders.

The valve spring washer lock is a small ring which is produced to ex-

ceedingly fine tolerances dimensionally as well as to surface finish. It is turned from bar stock in 1 1/4 in. Conomatics, and rough ground on the OD. The bore and face radius are finished in one setting in a specially designed Ex-Cell-O precision boring machine, operated at extremely high speed. Finish is held to 15 micro-inches for this operation. Face grinding operations are done on Blanchard grinders.

The knuckle pin locking plate, one of the most intricately machined pieces

made here, is produced from forgings which are hardened, quenched, degreased, and drawn before they come into the machine shop. Boring, facing, and turning operations are done on Warner & Swasey turret lathes; rough and finish-facing of fingers, counter-boring, grooving, etc., on New Britain-Gridleys. The bore is ground in a Heald Sizematic. Contour of the fingers is rough-milled to size in a four-spindle Cincinnati Hydro-Tel. Operations are interspersed with grinding of sides, fingers, etc. Holes are drilled and reamed on a Natco drill, taper-reamed and end milled. The contour of the fingers then is finish-milled in a Cincinnati vertical milling machine.

Each of the six fingers has a group of three tiny angular oil holes which are drilled in a special indexing fixture, one at a time, on a Walker-Turner bench drill. The work is sandblasted, then proceeds through a series of finish-grinding and polishing operations on the fingers. The ends of the fingers are finally cam-ground to size on a 10 x 18 Norton cylindrical grinder fitted with an Ohio Units cam-grinding attachment. Spline teeth at the inner bore are cut on Fellows gear shapers.


Following another series of grinding and polishing operations, the work is transported to the silver-plating department for the deposition of silver on the contacting face. This coating is rough-faced in an Ex-Cell-O precision boring machine, later finished on the same machine.

The crankshaft plug is another example of an intricately machined part. It is formed and cut-off on a four-spindle Conomatic in the screw machine department, ground and copper-plated. In the heat treatment, the work is carburized in Homocarb furnaces, cooled in an L & N cooling pot, drawn in a Homo furnace, and sand-blasted. Then it is form-ground on a Cincinnati centerless grinder, drilled and reamed in a Kreuger drill press, slots milled on a No. 2 Milwaukee mill. Several holes, including angular holes, are drilled on 2-spindle Edlund drills.

The work returns to the heat treating department for hardening in an Ajax salt bath furnace, washing in a Detrex degreaser, drawing in a Homo furnace, sand-blasting. The plug then is ground on a Norton cylindrical grinder and a Blanchard surface grinder. These operations are supplemented with other grinding operations on Brown & Sharpe external grinders, and Blanchard grinders.

An interesting feature of the procedure is the introduction of a series of sand-blasting operations at various stages of machining and grinding. This was done to eliminate difficulties with corrosion of surfaces during the long sequence of operations. It is claimed that sandblasting spotted through the machining and grinding cycle eliminated all trouble originally experienced with rusting or corrosion of the finely finished surfaces.

BUELL AIR COMPRESSOR



BUELL Air Compressors are used on bomber and fighter planes to operate brakes and machine guns. Here, where reliability is of first importance, their fine workmanship and precision manufacture pay real dividends in dependable operation. 12 years of operation on cars, trucks, buses, boats and railway trains was the proving ground for their adoption as an aviation accessory.

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WEIGHT 5 LBS.

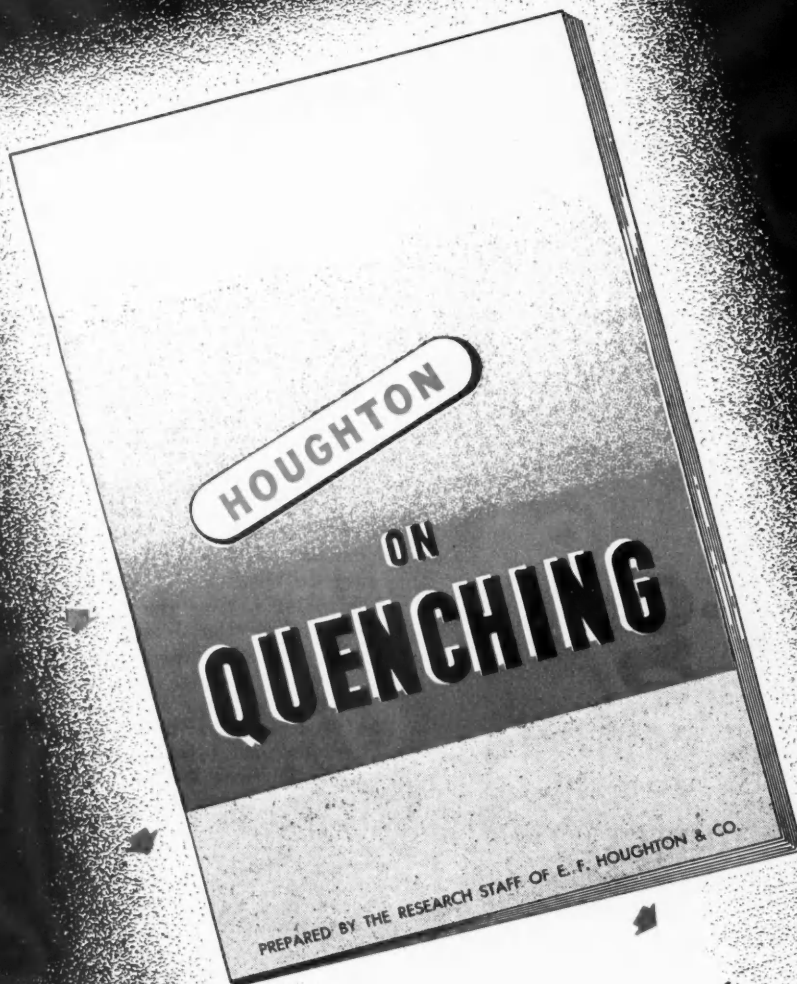
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How Do You Specify Steel?

(Continued from page 19)

and at the quenched end to 4 deg. per second at the other end. Laboratory tests have indicated how rapidly different sized bars cool at the surface, half radius and center in both water-quenching and oil quenching. A tabulation of these cooling rates is shown in Table 1.

Table 1—Cooling Rate of Round Bars

Rate of cooling in degrees Fahrenheit per second for the surface, $\frac{1}{2}$ radius and center of 1 in., 2 in., 3 in. and 4 in. rounds—both water and oil quenched.

Quench Media	1 in. Rd.	2 in. Rd.	3 in. Rd.	4 in. Rd.	Position
Water	850	550	400	100	Surface
Oil	120	58	30	15	
Water	135	46	27	14	$\frac{1}{2}$ Radius
Oil	53	24	12	$\frac{6}{16}$	
Water	100	32	15	8	Center
Oil	45	18	9	$\frac{5}{16}$	

From Table 1 it is easy to determine how fast any particular part will cool by whatever method of quenching is to be used. In order to check the effect of this quench on the part being heat treated, it is only necessary to observe the hardness of the Jominy sample at the point having the same cooling rate. The hardness observed on the Jominy sample can safely be assumed to very closely approximate that which will be developed on the heat treated work *having the same cooling rate*.

The advantages of such a method of specification can be illustrated by the following example: Assume that based on past experience the steel selected for a certain application was A-3135. If the quantity involved is sufficient, two heats might be shipped from the producing mill. These two heats might have the analysis listed below as Heat "A" and Heat "B."

	Heat "A"	Heat "B"
Carbon	0.34	0.38
Manganese	0.62	0.76
Silicon	0.22	0.31
Nickel	1.15	1.40
Chromium	0.57	0.74
Grain Size	#8	#5

It should be noted that both of these heats fall within the published analysis limit of A-3135. Obviously there would be considerable difference in the hardenability of the two steels, particularly in the depth of hardness penetration. It is quite possible to imagine that the Heat "A" might be too low or Heat "B" too high in hardenability for the application for which they are purchased, although they both would meet the specification A-3135, with grain size 5 to 8. Had these steels been ordered as Type A-3100 with a reasonable hardenability range specified, known to be suitable for the application, both heats could be applied and satisfactory results secured without change in the heat treatment.

It must be remembered, of course, that no mill can melt to an exact chemical specification and for this reason all steels are specified within a chemical analysis range. It is equally true that no mill could produce steel to an exact hardenability specification. Therefore, a hardenability range must be selected which will allow for normal production variation. If a reasonable hardenability range was specified and if the mill were not confined to a specific analysis range, they would probably have a better chance of furnishing a satisfactory product on the hardenability basis.

Alloy Steel Classification on Hardenability Basis

In carrying the idea of specification of alloy steel on a hardenability basis to a logical conclusion, it might be possible to speculate on the adoption of about 12 major standard alloy compositions which would be similar to the following types and would apply to most of the structural alloy steel tonnage now produced.

Alloy Steel Composition

Suggested Identification

Nickel: Type 2300.....	N-1
Type 2500.....	N-2
Chromium: Type 5200.....	C-1
Molybdenum: Type 4000.....	M-1
Chromium Nickel: Type 3100.....	CN-1
Type 3200.....	CN-2
Chromium Molybdenum: Type 4100.....	CM-1
Nickel Molybdenum: Type 4600.....	NM-1
Type 4800.....	NM-2
Nickel Chromium Molybdenum Type 9400.....	NCM-1
Type 8700.....	NCM-2
Type 4300.....	NCM-3

In these 12 suggested steel types the range of alloying elements would be considerably broader than those now used in specifying alloy steel. Carbon, of course, would be eliminated from the specification entirely and a simple system of letters or numbers could be adopted to identify the different analysis types. If a quick hardenability test could be made on a heat of steel before tapping, then by furnace or ladle additions the steel could be brought to the proper hardenability range and the inconvenience and expense of off heats would be materially reduced.

This idea may be reaching rather far into the future, but sufficient experimental work has been done to indicate that very interesting results can be secured from a cast sample by the Jominy method and that the results so obtained correspond very closely to those secured from finished bars of the same heat. The time element required for making the Jominy Hardenability Test on a cast sample and the rate of loss of oxidizable hardening elements, such as chrome and manganese, would have to be closely coordinated so that the method would introduce some very interesting problems in furnace operation and control. There seems to be a general thought among producers and users of alloy steel that if such a scheme could be worked out it would be worth considerable time and effort to both the steel producer and to the user.

In order to pass on to our customers the advantage of hardenability information, we are now conducting Jominy Hardenability Tests on each heat of alloy steel as it comes from the producing mill. From our tests, we prepare a chart showing the Jominy Hardenability results of the heat in the "as quenched" condition and also at draws of 1000 F, 1100 F, and 1200 F. These Jominy Hardenability results are then interpreted for obtainable physical properties for bars in 1 in. Rd., 2 in. Rd., 3 in. Rd. and 4 in. Rd., at the three draw temperatures indicated. These results are also put on the data sheets which are sent with each shipment of alloy steel from that particular heat. This system furnished the customer a quick, accurate picture of the heat-treatment response which can be secured from the alloy steel which he has bought. It is believed that this information will effect a considerable saving of time and experiment in the customer's plant.

Obviously, the Jominy test as ordinarily run indicates the hardenability of the steel only in the "as quenched" condition. Most alloy steel is used after having been quenched and drawn and we have, therefore, devised a means for interpreting the Jominy test for steel which has been quenched and then drawn at 1000° F, 1100° F, and 1200° F. The method of doing this is to harden the Jominy sample in the normal fashion, using four samples and reporting the results on one sample. Then draw the other three samples at 1000° F, 1100° F, and 1200° F, respectively. After the samples have been drawn, the Rockwell hardnesses are then taken and from these the physical properties are developed.

On the back of each chart the detailed method of determining physical properties from the Jominy curves is described. It is believed that this information will be interesting and helpful to all those who are interested in heat treating steel because it represents a new and very practical method of determining just what can be expected from any steel which is to be heat treated.



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Synthetic Rubber Progress Report

According to Progress Report No. 4, issued November 10 by Bradley Dewey, Rubber Director, the supply of tires and other essential rubber goods continues short, and will be so for a long time, but given adequate feed stocks, fuel and other essential materials and labor, no one need worry about this country's ability to produce synthetic rubber. Availability of synthetic rubber, however, does not immediately assure an adequate number of rubber products. The synthetic rubber construction program is being completed

far later than was wished, and as a result, many of the corollary programs necessarily had to wait until experience with the use of synthetic rubber could be gained.

Eighty-seven per cent of the butadiene-from-alcohol plants have been completed and thirty-nine per cent of those producing butadiene from petroleum. This is due to three principal factors:

1. Ninety-six per cent of the butadiene-from-alcohol plants received the highest priorities (first directive) while only forty per cent of the petroleum plants had that priority advantage.
2. The three butadiene-from-alcohol

plants at Institute, Louisville, and Pittsburgh (Kobuta) are made up of eleven identical twenty thousand ton units which involved only one design problem and simplified building of duplicate units.

3. A major raw material for butadiene from petroleum sources is butylene made in the cracking of oil, largely by the use of the modern catalytic cracking processes now being built for the high-octane gasoline program. The oil industry has undergone a huge expansion program to supply this material as well as other materials for the production of butadiene and high-octane gasoline.

As of October 31, 1943, the program had progressed to the point where completed plants have a rated annual capacity of 646,000 long tons of rubber. This progress is best shown in the tabulation below, which includes the status of construction of plants producing butadiene and styrene:

Product	Rated capacity	Rated capacity of construction completed 10/31/43	Per cent completed
Buna S	Long tons 735,000	Long tons 585,000	80
Butyl	75,000	21,000	28
Neoprene	40,000	40,000	100
	850,000	646,000	76
Butadiene:			
From Alcohol	Short tons 230,000	Short tons 200,000	87
From Petroleum	480,400	179,900	39
	690,400	379,900	55
Styrene	202,700	163,700	81

With both crude and synthetic rubbers, the 1944 supply will be made up of some very cheap and some abnormally high-priced tonnages. Faced with this situation, the approach has been to average all of the costs of all of the synthetics under present conditions, and all of the crudes now being obtained, and then price the various rubbers in such a way that those who are required to use any particular synthetic are not at a serious disadvantage when in competition with those using another.

Based on the above reasoning, crude and synthetics used in making Government products are priced per pound as follows:

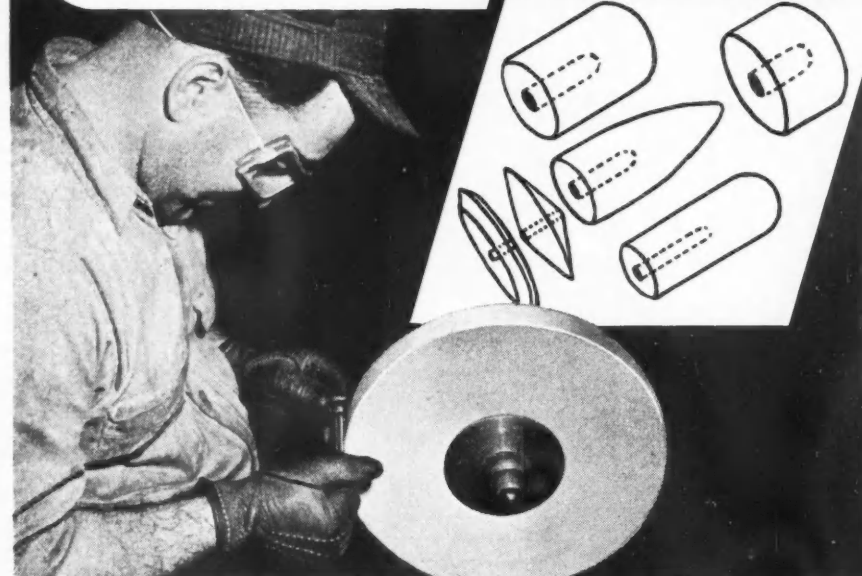
Crude rubber — \$0.40; Neoprene (GR-M)—\$0.45; Buna S (GR-S)—\$0.36; Butyl (GR-I)—\$0.33.

The Office of Rubber Director initially recommended a uniform price policy. Being forced, however, to accept certain limitations as to ceiling prices of civilian consumer goods placed upon the OPA by statute and Executive Order, the Office of Rubber Director and the Rubber Reserve Company agreed with the OPA in March to the establishment of a civilian price schedule lower than the above. The advisability of continuing this policy is now being reviewed.

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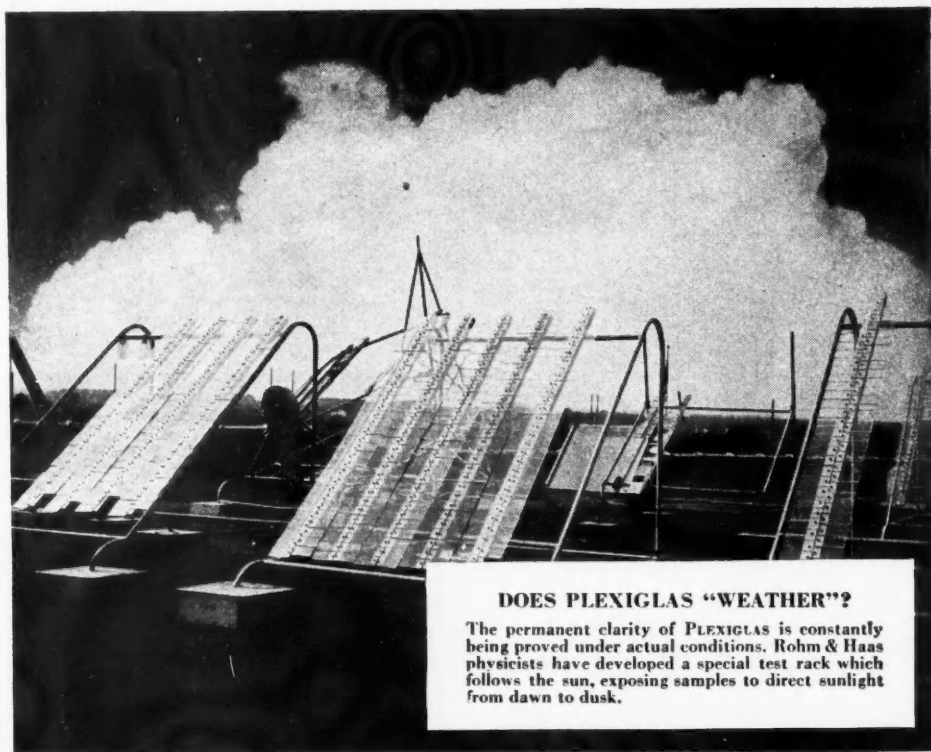
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UNDER war-time pressure, years of research and testing are being packed into a few short months at the new Rohm & Haas Physics Laboratory.

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In addition, special equipment is designed and constructed to solve special war-time problems—to determine, for example, the behavior of PLEXIGLAS panels under the conditions at which high altitude planes must operate—to observe how tensile and flexural strength are affected by temperature changes—to select suitable cleaners and polishes for PLEXIGLAS—to find the answers to hundreds of other questions that Army, Navy, and war production engineers ask about PLEXIGLAS.

Today, this intensified research is helping to win the war. Tomorrow, it will help you to design better peace-time products.



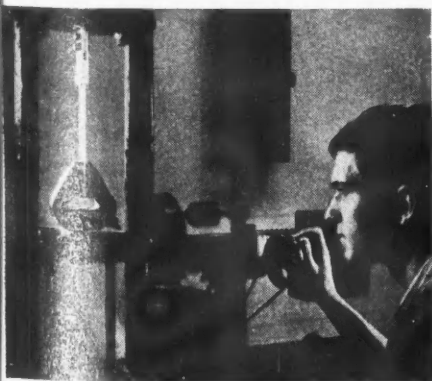
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A recent Physics Laboratory report based on tests similar to that shown above covers the pin-load bearing strength of PLEXIGLAS in detail. Write for a copy on your letter-head.

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Manufacturers of Chemicals including Plastics . . . Synthetic Insecticides . . . Fungicides . . . Enzymes . . . Chemicals for the Leather, Textile and other Industries



Martin to Build A Larger Plane

(Continued from page 52)

by Goodyear. In addition, the industry is making airframe parts and subassemblies for 11 other types of combat aircraft and for three types of cargo planes. A dozen different types of aircraft engines also are being made by erstwhile automobile manufacturers.

Ford Motor Co., which took on the production of Consolidated B-24 bombers, both on a completed basis and as knocked down assemblies for shipment

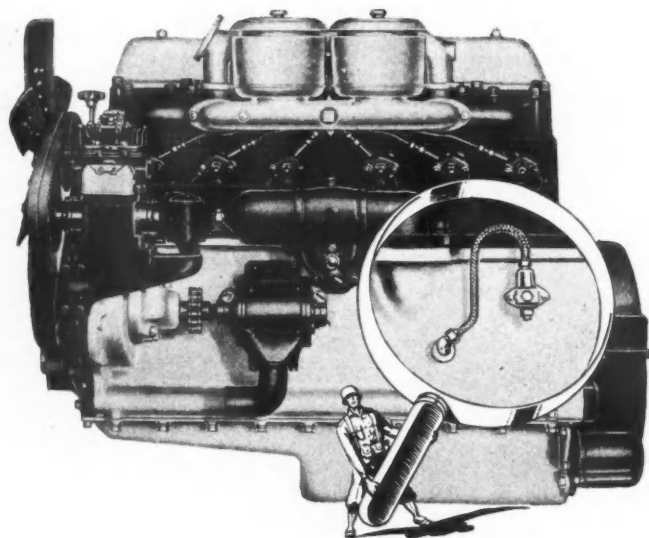
to plants in Tulsa, Okla., and Fort Worth, Tex., recently was cited by WPB for its efficient manufacture of these aircraft. Ford was credited with output of 80 pounds of airframe weight per employee in August compared to a nation-wide average of 60 pounds per employee for 22 plants. Dispersal of production of airframe components from Willow Run to other Ford plants in the southeastern Michigan area has been responsible for speeding up deliveries. Labor is more readily available at these plants, some of which have had contracts for tanks, amphibian jeeps and gun directors cancelled or drastically curtailed.

The Highland Park plant, formerly the site of Ford's M-4 and M-10 tank production, has been converted to the manufacture of nose side panels, fuselage tail cones, outer wing sections and various hydraulic assemblies. Space at the Lincoln plant formerly used for fabricating amphibian jeep bodies now is devoted to wing bulkheads, nose rings, air ducts and motor "dress-up" on the 1,200-hp. Pratt & Whitney engines that power the B-24. The tire manufacturing building at the Rouge is used for assembly of bomber landing gears, machining engine parts and fabrication of fuselage canopies, tail assemblies and ailerons. All the Ford tire-making equipment was shipped to Russia under lend-lease some months ago.

The OWI combat aircraft report warned that the goal of 100,000 planes this year probably will not be achieved. It stated, "Although more planes are being built than ever before—7,598 were produced in September, according to WPB—the rate of increase month by month is lower than that which was originally scheduled and the monthly figure of 10,000 by the end of the year may not be reached. For this a number of factors are to blame. The constant, necessary change of models is the most important of these factors. Explaining this, Donald M. Nelson, chairman of WPB, said in a recent report on aircraft production: 'Our plant production has now reached a point where we can afford to take slight temporary losses in production in order to get a more effective model. Since the combat efficiency of a plane can be determined only through actual fighting experience, design changes will always be necessary if we continue to refine and develop our fighting planes to secure the ultimate in fighting efficiency.' Other causes of deficits in the production of combat airplanes include engine shortages, models still being developed, maldistribution of raw materials, reorganization of plant layout, making up shortage of spares and labor shortages."

After that report was issued, Nelson announced October output of 8,362 planes, a numerical gain of 10 per cent over September. This included the largest number of heavy bombers ever produced in one month.

Over-all munitions production in September was approximately the same as in August, registering a one-point gain on the WPB index. Aircraft production was down 14 planes from 7,612 in August to 7,598, but was up 4 per cent on a dollar volume basis and 3 per cent on an airframe weight basis. Heavy bombers increased 6 per cent. Ammunition registered a 3 per cent advance over August, while small arms and infantry weapons increased 13 per cent, anti-aircraft guns and equipment 2 per cent and self-propelled artillery 1 per cent. Motor vehicle output was down 5 per cent and combat vehicles declined 19 per cent, indicating the cutbacks in the tank and track vehicle programs.



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It's a VISCO-METER* installation on a Diesel Engine. It wouldn't look any different on a gasoline engine. Engines that could be powering your car, an Army Jeep, a motor ship or a farm tractor.

You are looking at a 12 ounce guardian of engine life, operating efficiency, operating economy. While the VISCO-METER* is simplicity itself in both design and operation, the technical story of its

adaptation to *your* engines is something we should discuss together.

If you are concerned with the design, manufacture, sale or operation of engines and are interested in protecting them from lubricating troubles then we invite you to write, wire or telephone us today for VISCO-METER* literature or tell us when you want a VISCO-METER* engineer at your office.

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Tested on every battle front, used by every major U. S. and Canadian aircraft company. Over 150 million now in service.

12,000 production types and sizes for all aircraft to save you money in simplicity of installation, long life, ease of maintenance, low cost upkeep.

Ask our nearest engineering service office for free catalog with authoritative information about the correct support for electric conduits, fuel, oil, instrument, and hydraulic lines. And if you hear claims that other line supports are "just as good" as ADEL'S, please bear in mind that it is always a safe bet to use what others try to imitate.

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SUPPORT OUR BOYS
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November 15, 1943

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CIO Favors Elimination Of Little Steel Formula

(Continued from page 48)

hours, the previous payment, because most plants are operating on a 48-hour basis. Employees with five years or more service as of July 1 were granted 96 hours' pay instead of 80 hours as previously. The UAW-CIO had sought 24 hours' pay for those with six months seniority up to 96 hours' pay for three years' service.

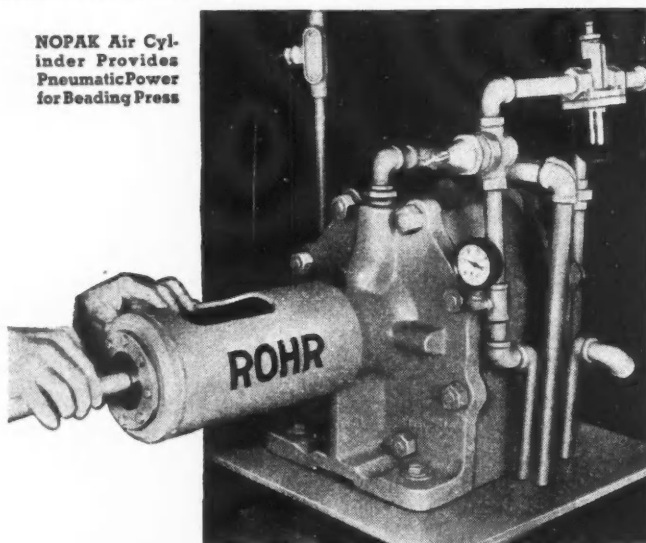
Despite the recent renewal of the no-strike pledge by the UAW-CIO at its annual convention at Buffalo, em-

ployes in the Flint plants of the Chevrolet Motor Division of GM recently voted in favor of a strike in an NLRB poll conducted under the War Labor Disputes Act. Seventy-nine per cent of those voting favored a strike in this war industry, 8,099 voting yes and 2,070 voting no. An accumulation of 21 petty grievances, including failure to upgrade workers, refusal to advance pay rates under contract provisions, unfavorable working conditions for women and revocation of smoking privileges were cited by officers of the local as cause of the action. Approval must be gained from the international union before the strike is authorized.

Intra-union politics involving factions headed by Walter P. Reuther, GM Dept. director, and George F. Addes, secretary-treasurer, were seen in the dispute.

Only 8,471 workers in 28 Michigan war plants were involved in strikes in September compared to 25,888 employees in 29 plants during August. However, work stoppages have increased since that time, provoked chiefly by objections to discipline and protests by Negro workers over failure to be upgraded. The fifth strike in two months in the export shipping dept. of the Dodge Truck plant, Detroit, resulted in the firing of 29 Negro workers, with the concurrence of the Army and Local 140 of the UAW-CIO. The 29 were dismissed for inciting a strike after they protested the discharge of a Negro woman worker who refused to do the job assigned to her following an unexcused four-day absence.

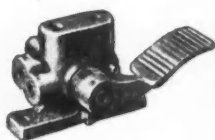
NOPAK Air Cylinder Provides Pneumatic Power for Beading Press



Beading Time Cut 95% in Rohr Tubing Department

A novel tube-beading press has been developed at the Rohr Aircraft Plant, which puts a bead on chrome or monel tubing in 2 to 3 seconds; 20 times faster than previous methods!

The heart of this press is its unique die-assembly which works like the collet in a screw machine. An expansible rubber inner die, inserted in the tube end, is pulled into a 4-section metal outer die. The expansion forces the metal into the beading cavity of the outer die. Dies for various tube sizes can be changed in 10 seconds or less.



NOPAK Cylinders are at their best when controlled by NOPAK 2-, 3- and 4-Way Valves—Hand, Foot or Solenoid Operated.

Dependable pulling power for this fast-working press is furnished by a Standard NOPAK Model "A" 12" Air Cylinder, controlled by a foot valve. Turning out "beads" at the rate of 20 to 30 per minute establishes NOPAK Cylinders as a dependable source of pneumatic power for continuous high-speed production operations. Ask for Cylinder Bulletin 82-A.

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A 4234-1/2 I-A

Air Transport Has Postwar Problems

(Continued from page 42)

Commerce. Equipment now being developed toward that end includes automatic communication and posting systems for handling flight data at traffic control centers, airport traffic control towers, airline radio stations and military operations offices; a ultra-high frequency radio range, which will enable a pilot to follow his course by means of an indicator on the instrument panel giving in degrees the position of the airplane on either side of the on-course signal; an anti-collision device called the "vertical separation indicator," signals of which would represent to the pilot the position of other aircraft; automatic position reporting devices for relaying pilots' reports; ground station aircraft detectors, and automatic direction finding instruments for long-distance aircraft flying above 12,000 ft.

Edward P. Warner, vice-chairman of the Civil Aeronautics Board, gave an analysis of the local air transportation in the United States, pointing out that 64 per cent of the people now live within one hour's highway travel distance of points now certificated to receive air transportation, but that the number of stops on air transport routes would have to be increased from the present 284 to 1600 for 95 per cent of the population to be so reached directly.

Airport runway patterns were discussed by John C. Leslie, manager of the Atlantic Division of Pan American Airways, and the problems encountered by pilots during weather were presented by Robert N. Buck, pilot captain of Transcontinental and Western Air.

F. W. Reichelderfer, chief of the U. S. Weather Bureau, predicted that operating efficiency will force further development and extension of the weather service, especially for trans-oceanic operations.

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aviation insure better
peacetime performance**

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PISTONS..PINS..

HARDENED & GROUND PARTS

War demands new and higher standards of performance and stamina in aviation parts. McQuay-Norris with a third of a century experience in making automotive precision parts is now extending its services to the aviation industry in increasing measure. McQuay-Norris' policy of clinical research is carried out by our Aircraft Division which offers the industry various precision parts, technical assistance and research experience. Your inquiries are invited.

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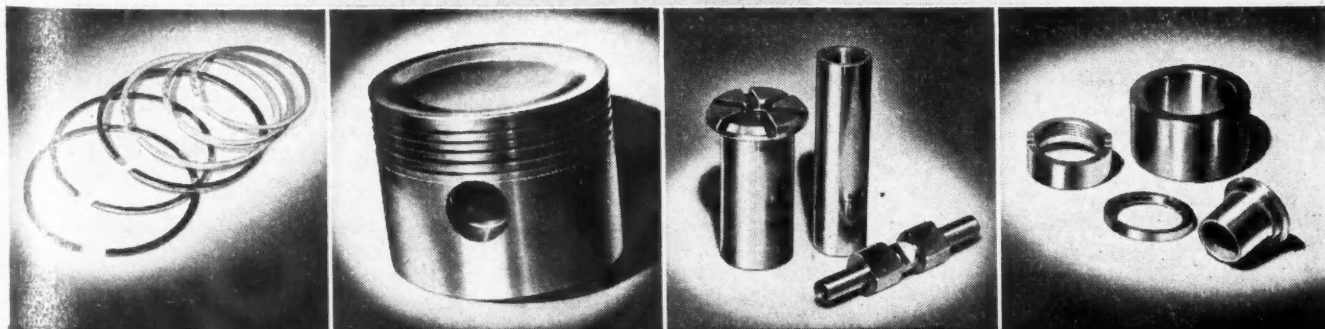
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McQUAY-NORRIS MFG. CO. (AIRCRAFT DIVISION), ST. LOUIS, U. S. A.

CANADIAN PLANT, TORONTO, ONTARIO

Applications of Flash Welding in Aircraft Production

(Continued from page 32)

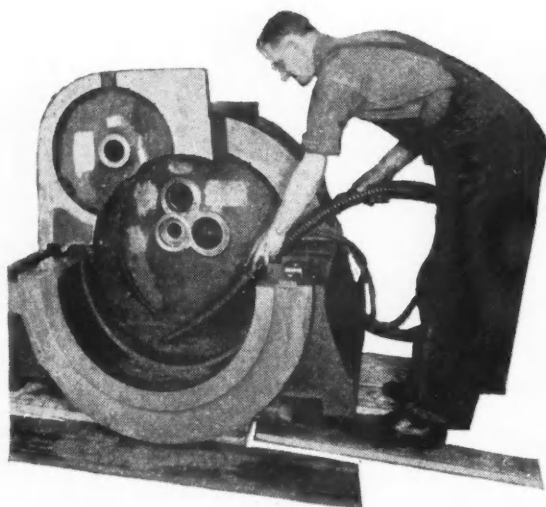
nism accurately controls, by means of the hydraulic system, all the characteristics of a large machine capable of welding the heaviest sections.

Tooling Requirements

While V-shaped dies have been in common use for many parts, it is felt that they do not give satisfactory

clamping or electrical or thermal conducting properties for ensuring the grade of welding required of aircraft parts. Much better results are obtained if the contour of the die fits that of the part which it grips, at least in the region next to the weld area.

Typical locating fixtures as shown in Fig. 4 have been used in production



A FAST PICK-UP!

WITH SPENCER VACUUM

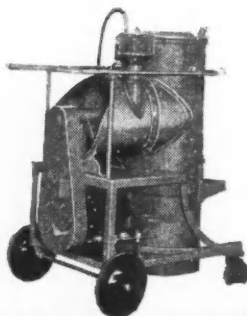
It's the chips
that get into the
work that hold
production

back these days — unless you provide your men with Spencer Vacuum.

Then it's a matter of seconds to clean patterns, castings, or interior of tanks, guns, and planes. Hours are saved on bench cleaning and rejects caused by dirt and dust disappear. Valuable materials are easily reclaimed.

Of course it's ideal for floors, walls, and ceilings, too. One stationary system can be piped to an entire building, or portables of 1½ horse-power up can service individual departments.

Ask for the Bulletins.



243 M

SPENCER VACUUM
HARTFORD
CLEANING
THE SPENCER TURBINE COMPANY, HARTFORD, CONN.

to hold finished parts to overall tolerances of less than ± 0.010 in., with angular alignment between the holes in the opposite ends of $\pm \frac{1}{2}$ deg.

Machine Settings

Among the machine settings of particular importance in air craft flash-welding are: (1) *Current setting.* This is usually done by means of a tapped auto-transformer, or by taps on the welding transformer, thereby regulating short-circuit current, and, indirectly, the flashing current. However, for any given setting, the actual flashing current is somewhat dependent on the rate of travel of the platen. An alternate method of current regulation is by means of the conventional Thyatron phase-shifting control similar to that used on the better types of alternating current spot welders. However, this method, in its present form, does not seem to have general acceptance in the industry due to certain inherent factors which do not seem suited to the flash-welding operation.

(2) *Time of Current Cutoff.* Normally, the welding current is cut off about the time of upset. However, it has been determined that with very thin-walled tubing, especially at the lower range of machine capacity, it may be advisable to cut off the current slightly ahead of the upset, to avoid overheating the weld. As heavier sections are welded, the optimum cut-off time is progressively later. This time relation has been determined to be quite critical for steels of the type of SAE 4130, and may well make the difference between good and bad welds.

(3) *Final Die Opening.* While not as critical an adjustment as some others, this has, perhaps, not received as much attention as it should. After the current is cut off the welded area begins to cool, the heat being mainly abstracted from the part of the dies, which are usually water-cooled. It is apparent that the cooling rate of the weld and the heat-affected area adjacent to it, will be a function of the distance from the weld to the dies. This factor assumes considerable importance in the welding of aircraft types of alloy steels.

For the welding of tubing, most operators consider that the die openings, rate of travel, amount of flashing and amount of upset are functions mainly of the wall thickness, and are affected by the tube diameter or cross-sectional area only at the ratios of diameter to wall thickness of less than about 15 to 20, which would be comparatively thick-walled tubing for aircraft use.

Fig. 5 is a time-travel diagram of a typical flash welding cycle, to which has been added the current-time relationship.

Inspection Methods

The inspection of flashwelded joints by the methods in common use for fusion welding has not been entirely

Indispensable



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Jones & Lamson Optical Comparators are used to inspect positively and rapidly punches and other products with symmetrical and irregular contours held to close limits, at the Westmount Tool Works, Canada.

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are indispensable for the accurate, rapid inspection of irregular contours that are held to close limits. By no other means can they be inspected as positively and as rapidly.

Because of wartime restrictions we cannot illustrate many of the remarkable applications of these **Comparators**, how

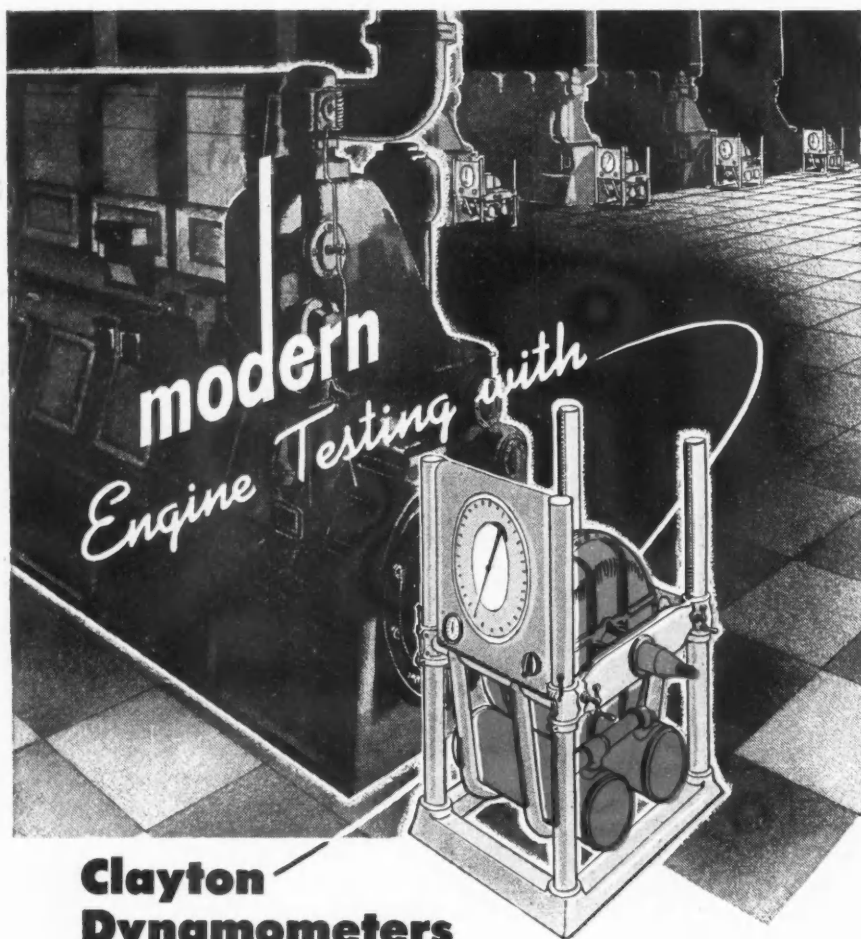
their use has solved seemingly impossible inspection problems and helped to speed the production of vital products. But—our inspection engineers are available to study your inspection problems and give you the benefit of more than twenty years' experience, pioneering and developing Inspection by Optical Projection.



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Clayton Dynamometers

Mass production of engines...for ships, planes, trucks and tanks...demands new testing equipment...that is accurate, easy to operate, low in cost and built with a minimum of critical materials.

Clayton meets this demand with "Turbo Closed System" Dynamometers that are laboratory-accurate over the entire power range, instantly adjustable to any load conditions, and promptly available at moderate prices.

Automotive, marine and aircraft engines are now factory and field tested with Clayton Dynamometers which combine the exclusive Clayton closed cooling system with the high efficiency of the turbine type hydraulic power absorption unit—to produce the most compact, simple and efficient engine testing equipment.

The complete line includes engine and chassis models, from 50 to 4,000 H.P. for laboratory service and production use. Illustrated above is a fully equipped, vertically adjustable shaft height Clayton Dynamometer for production run-in of slow speed engines developing up to 2,000 H.P.

Other Clayton products serving the Armed Forces are Kerrick Kleaners...Kerrick Cleaning Compounds...Clayton Steam Generators...Clayton Boring Bars and Bar Holders, and Clayton Hydraulic Liquid Control Valves.

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successful. Numerous X-ray inspections of test specimens have failed to correlate with the physical strength of such specimens. Magnetic particle inspection has been only slightly more successful, in that while it will reveal very bad flaws due to lack of fusion, or to inclusions, it has not, as yet, been able to differentiate between good joints and those which, while containing no obvious serious flaws, are nevertheless considerably below the required 100 per cent strength. Several electrical testing methods, both by means of direct application of current, and by the inducing of eddy currents through the weld, give some promise of success, but are, as yet, not commercially available.

It is believed that the best available inspection method is the close control of the equipment and the process. In the case of spot welding, there is no ready non-destructive testing method, but due to the method of qualifying the machines, and of process control, the spot welding process is being successfully extended into aircraft structural use. A similar method is in use in many aircraft plants, in which the flash welding equipment is carefully specified, and sufficient test specimens welded on any new equipment to prove its consistency at any particular machine setting.

On all production lots of parts the following procedure is then followed: On the first lot of each new part, four test coupons are furnished for each different weld. The test coupons are made from parts which are nominally identical to the production parts with respect to material, heat treatment, welding before or after heat treatment, diameter and gauge. Three of the coupons are tested to destruction in tension. The failing load shall not be less than the test load specified, which is the minimum guaranteed ultimate strength of the parent material. The fourth coupon is, at the discretion of the inspector, subjected to macroscopic and/or microscopic examination or other suitable test.

In addition a coupon is made and subjected to the test load after each 25 succeeding welds, and at the end of a lot if it consists of less than 25 welds, to indicate consistency of welding conditions. No strength tolerances below the test load are permitted. Failure of any coupon below the test load during a production run is cause for testing of the preceding lot of 25 welds to determine their acceptance or rejection.

Before proceeding with any subsequent production run of parts, the machine adjustments are checked by at least two test coupons prepared and tested as above, and additional tests are conducted throughout the run as previously described. It has been determined that, if the equipment is of the proper type and properly qualified, this method will result in the obtaining of 100 per cent satisfactory welds, since any breakdown in either machine or process immediately shows up in the destructive test.



Battery of Type "D" Multi-Au-Matics in a large airplane engine plant, machining cylinder barrels.

PRODUCTION

"Line of Battle"

Two urgent demands, from this all-out war, have brought into being many batteries of Bullard Multi-Au-Matics like the one shown here: The demand for production in overwhelming volume. And, no less important, the demand for the uncompromising accuracy which gives to airplane engines their fighting edge.

Since Multi-Au-Matic production is continuous production . . . since accuracy that meets fine-tolerance standards is built into its sturdy construction . . . and since the Multi-Au-Matic delivers both these essentials at marked savings of man-power and floorspace, the Multi-Au-Matic is the natural choice for scores of urgent war jobs.

* * * * *

And when peace is won—a little time for retooling, and they'll contribute this same volume-with-precision to important new tasks.

THE BULLARD COMPANY
BRIDGEPORT 2, CONNECTICUT

New Production Equipment

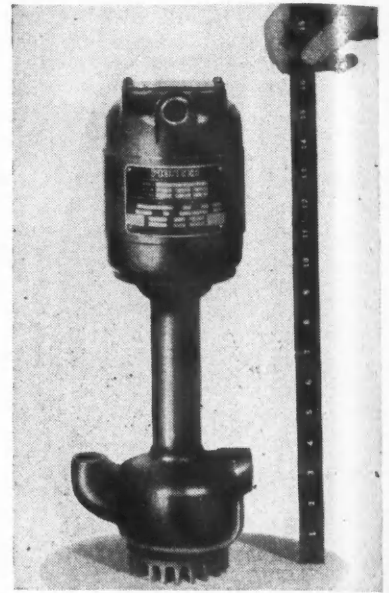
(Continued from page 44)

range of the instrument at one time.

In addition to checking, these rolls are extremely useful in setting up jobs where dial indicators and amplifiers are to be used.

The set is housed in a transparent plastic case which provides necessary protection, gives a clear view of the contents and insures that all rolls are in place when the set is returned to the tool crib.

A SMALL sized, seal-less pump is the latest addition to the line of the Pioneer Pump and Manufacturing Co., Detroit, Mich. It is identified as Model MVA and was designed to meet the needs of operators of small machines such as hand mills, surface grinders, internal grinders, drill presses, tapping machines, and the like. This small pump, just short of sixteen inches in height, has all the character-

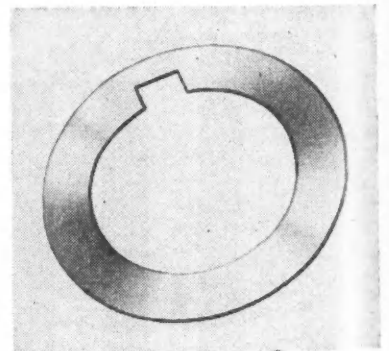


Model MVA Pioneer pump.

istics built into the full sized counterparts recently developed by the same company.

Described as a submerged type pump, this model is intended for machines having a coolant pump in their base or for machines provided with separate coolant tanks. In the case of the latter, brackets and flanges are available for mounting pump on the edge, side, or top. Chips or dirt that will pass through the grille located in the bottom of the pump will readily pass through the pump without injuring it.

TO MEET present day demands for close tolerance milling jobs, the Detroit Stamping Company, Detroit, Mich., has added a .0015 in. metal



De-Sta-Co arbor spacer.

spacer to their line of De-Sta-Co arbor spacers. his new .0015 in. spacer permits setting of milling machine cutters down to as fine as .0005 in. spacing. De-Sta-Co .0015 in. arbor spacers are available in all standard arbor sizes.

Two new light welding torches have been brought out by the National Cylinder Gas Company, Chicago, Ill. They are the Models 40NL and 41NL,

LIVE CENTERS*

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* No. 2 to No. 6 Morse taper . . . A properly designed Live Center is one of the fundamentals of setting up a job and requires a specialist's experience.

Characteristic of the design of all STURDIMATIC LIVE CENTERS is a low overhang and a slight cushioning action that compensates for expansion due to heat shock and excessive thrust loads—reducing wear to a minimum.

Send us your blueprints and specifications—we will see that your job gets set up with the right Live Center.

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**AIRCRAFT NUTS CLEANED BETTER AT HALF THE COST
WITH *PENNSALT CLEANER***



A New England manufacturer of parts for aircraft had a real problem in getting nuts free of oil and chips. The washing machine in use was of the rotary type with scoop action. A solvent cleaner was being used but it did not get the nut threads clean of very small chips. When the Penn Salt technician called, the manufacturer was trying another type of cleaner in connection with the solvent, but it showed no improvement.

The first Pennsalt product recommended did a thorough cleaning job, removing both the oil and the chips. After a long period of continuous operation, cleaning results

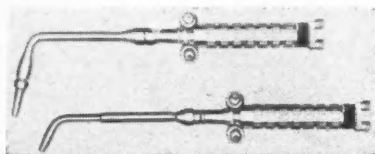
were still excellent and a comparison of costs showed a saving of 50% in favor of the Pennsalt cleaner.

It is possible that one of this famous family of cleaners can do as well—or better—for you. Our technical representatives will be glad to cooperate with you on any cleaning problem which you may have. No obligation whatever—and you will get the benefit of experience that covers the entire cleaning field. Write fully to Dept. AA.



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Models 40NL and 41NL welding torches.

and are designed for welding aircraft tubing, light sheet metal, aluminum, and various alloys.

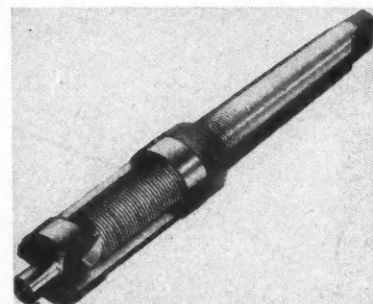
Model 40NL torch uses Style No. 170, short, screw-in tips made from special copper alloy. They are used

with a No. 39 tip head and No. 11897 mixer, which are parts of the Model 40NL torch.

Style No. 70 welding tips are fabricated from copper tubing brazed to heavy brass tubing, which is said to insure against heat being conducted back to the mixer and torch handle. They are used with the No. 12901 mixer, which is a part of the Model 41NL torch.

NASH-ZEMPEL Tool Division of the J. M. Nash Co., Milwaukee, Wis., has designed a new spot facer and counterboring tool with a cutter that

can be quickly removed for sharpening by loosening a knurled nut and cone nut, and slipping the cutter back out of the bar. After re-sharpening, the cutter may be replaced in the bar where it centers itself when tightening down



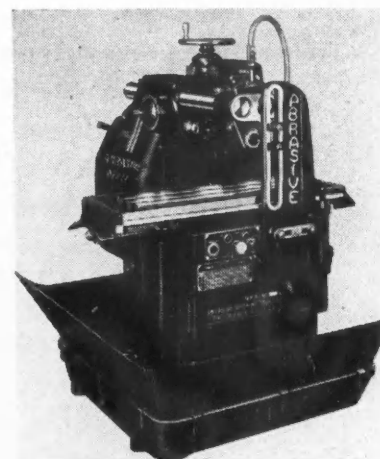
Nash-Zempel spot facer and counterboring tool

the cone and locking the knurled nut. Exact location is obtained by the web in the body which locates the fingers of the cutter, and the cone nut which centers the rear of the cutter on a straight line with the bar.

The pilot of this tool is tapped for a screw which holds bushings for various sizes of drilled holes. The body and cone nut are always smaller than the outside diameter of cutter, and the cutting edge of the cutter remains in the same relative position no matter how often the cutter is sharpened.

A PLAIN milling machine has been placed on the market by the Abrasive Machine Tool Company, East Providence, R. I. The new Abrasive Milling Machine, known as B-11, is a manufacturing-type unit with electrical control for table and spindle power movements. Its capacity is ample for most work of medium size and it is said to answer all ordinary requirements for efficient production milling.

The B-11 has a built-in backlash eliminator on the table screw which is released automatically during fast travel. This permits climb milling in



Model B-11 Abrasive Milling Machine.

PHOTO BY U.S. ARMY SIGNAL CORPS.



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either direction up to the capacity of the driving motors. Table movement can be changed quickly and precisely by means of the electrical controls. Other features include automatic reverse, fast table travel of 300 in. per minute and a wide selection of feeds and speeds.

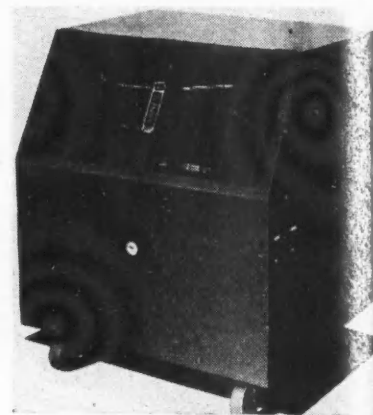
A WIDE purpose industrial fluid refrigerating system is now in production at the Gray-Mills Company, Chicago, Ill. This addition to their line, known as the Model 400, mechanically refrigerates fluids, settles and screens out chips and the coarser

Model 400 industrial fluid refrigerating system.

abrasives, and applies the coolant or fluid to the work through the medium of a self-contained pump.

The Model 400 is adaptable to the cooling and temperature maintenance of many industrial fluids, such as coolants for metal cutting, hydraulic oil applications, maintenance of submerged bearing temperatures, quenching oils, spot welders, and laboratory set-ups.

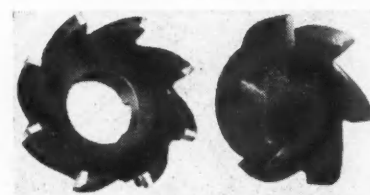
The unit is equipped with a 1 hp



compressor rated at 11,800 Btu's. Centrifugal or gear-type coolant pumps operated by a ½ hp motor are optional as required.

TO FACILITATE the application of the correct milling cutter to a particular piece of work, Farrell-Birmingham Company, Inc., Ansonia, Conn., is offering milling cutter bodies of Meehanite which can be machined for carbide or cast alloy tips within a broad range of rake and spiral angles.

A variety of body castings and cut-



Farrell meehanite milling cutters.

ting tips can be kept in stock by machine shops to use in making up cutters for many applications. The user faces, bores and slots the hub to suit his requirements, mills the tooth seats, and brazes on the desired tips. Carbide tips may be applied where a high grade finish is required and cast alloy tips used for heavy roughing operations.

Skin Protector Made By Commercial Solvents

(Continued from page 46)

poration, New York, N. Y. This product, which is called CSC Protector, is non-sticky, white and greaseless. The maker claims that it will not irritate sensitive skin or have any drying effect even after long and continuous use. CSC Protector coated hands leave no stains or smudges on tools, paper, or metals. The Protector is rubbed into hands and nails thoroughly before work is begun. It guards the hands for four to five hours after application. When work has been completed, the user cleans his hands as usual. The CSC Protector washes away, taking dirt and grime with it.

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GUARANTEE:
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Your operators will agree once they use this Perfix Angle Tangent to Radius Dresser, that it not only saves on set-up time but has many other advantages over the ordinary type dresser.

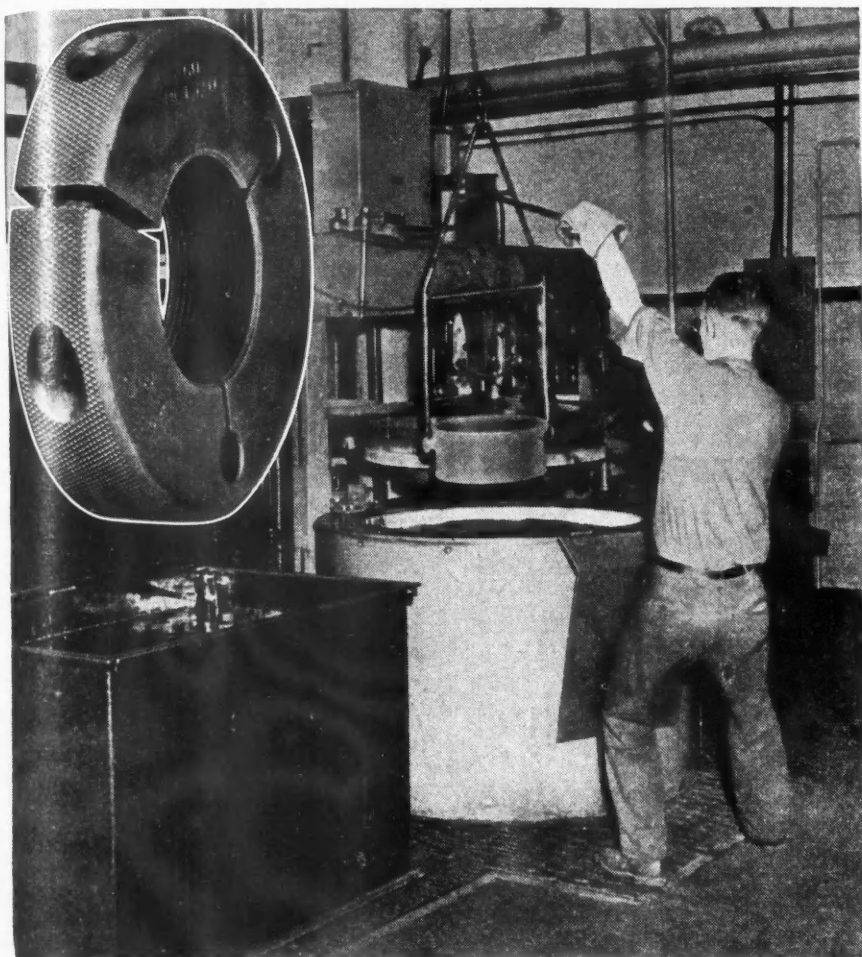
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|---|---|
| <ol style="list-style-type: none"> 1. Radius can be set accurately to within .0001. 2. It is possible to return the diamond to center after dressing an angle within .00005. 3. It is possible to dress a smaller than .050 radius to a full half circle without additional attachments. 4. The Perfix Dresser dresses in | <ol style="list-style-type: none"> horizontal position exactly in the plane in which the work will be ground. 5. The vernier is very legible, and can be easily read from normal position. 6. All moving parts made from hardest steel ground and lapped to a perfect fit. 7. All surfaces protected from rust. |
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Swinging a tray of plug and ring gages from the Homocarb Furnace to the quench tank in a Greenfield Tap & Die Corp's heat-treat. Insert shows typical GTD gage.

HOW HOMO CARBURIZING Helps Maintain Quality of Greenfield Gages

Carburizing of Greenfield Tap & Die Corp's thread gages is as truly a precision process as are the various machining, grinding and lapping operations which precede and follow the heat-treatment. For carburizing is relied on to give the gages the uniform, hard surface which will take a fine finish, and will also resist the wear to which even the most careful handling subjects a gage; and the securing of this surface is one of the most important of heat-treating processes.

To handle this process with accuracy, and in large volume, GTD some time ago adopted the Homocarb Method of carburizing. The results secured may be outlined as follows:

1. Gages emerge from the Homocarb Furnace with hardness and

depth of hardness well inside the permitted tolerances, so that tempering, grinding and finishing are made easier.

2. It is extremely easy to check up on the progress of carburizing at any point in the furnace cycle.

3. Work may be run in large or small batches, as the production schedule requires.

4. Gages are not packed for carburizing; more important, they're not unpacked for quenching and hence require no handling while they're hot and their threads easily dented.

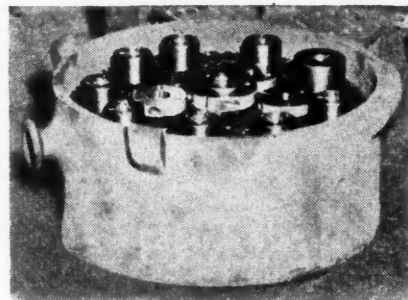
5. The various factors which govern the furnace operation are under automatic control: The carbon source (Homocarb Fluid) is uniformly pure, and is fed to the furnace at any rate desired; temperature is recorded and



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controlled by Micromax pyrometers; and the time of carburization is recorded. The equipment is thus a precise tool which accurately obeys the orders of foreman or operator.

Homocarb Furnaces are widely used not only in fine-tool work, but in aviation and similar plants where quality standards are high and production tonnage is immense. Gears, shafts, cranks, struts, shoes, pins and scores of other war-needed parts are being Homo-Carburized in such plants. Regardless of the type of part to be carburized, there's a Homocarb for the job, and our engineers are ready to help apply it to the specific problem. If you wish a catalog, please ask for T-623.



Gages are carburized in trays, as shown above; trays are nested to fill the Homocarb Furnace; charge is then heated in the special Homocarb atmosphere, which is created in the furnace at any rate the heat-treater selects. The gas is swirled past the furnace's electric heaters and through the load of gages by a motor-driven fan in the bottom of the furnace. It carries carbon to every exposed surface, so that the carburizing action is highly uniform. When carburization is complete, the temperature is dropped to the desired quench point; the furnace charge is then quenched, gages, trays and all, so that no gage is touched from the time it is loaded into the Homocarb tray until it has been quenched.

Homo-carburized work can, of course, be quenched directly from full carburizing temperature if desired; or it can be slow-cooled, either in the open or in a protected-atmosphere unit we can supply.



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MEASURING INSTRUMENTS • TELEMETERS • AUTOMATIC CONTROLS • HEAT-TREATING FURNACES

SAE National Aviation Meeting

(Continued from page 35)

Certain phases of the design job for the trainer were predetermined by the Air Corps specification, such as the fact that the ship was to be a two-place, tandem-seating, single-engine, low-wing monoplane with fixed landing gear and landing flaps. The airplane was broken down for assembly into seven major components—front and rear fuselage sections, tail assembly, wing center section, two outer wing panels, and

the engine section. This excellent design breakdown has been preserved throughout the development of the trainer series. As orders increased a distinct advantage developed in this type of breakdown, in that it permitted a maximum number of workmen to be engaged without confusion in the assembly of the major components of the airplane. The component breakdown system has since

been applied to B-25 Mitchel bombers and P-51 Mustang fighters with equal success, and it is felt that the Mustang's excellence from a production standpoint is traceable directly to the experience gained in designing, building and developing the trainer series.

Motion Analysis by Means of High Speed Photography

By H. D. Jackes,
Wright Aeronautical Corp.

RECENTLY the high speed motion picture camera has been utilized by Wright for time-motion studies, as a continuation of, rather than a replacement of stroboscopic investigation. High speed motion picture studies have the advantage of forming a permanent record and accurately evaluating transient conditions. Mere observation of the film records, projected at normal projection speed resulting in a 150X magnification, shows many motions to be far different than previously conceived, and will show what has transpired without need of a long and tedious education in the art of reading and analyzing oscillograph records, as is the case with records obtained from strain gages.

Some of the uses to which high speed photography has been put are as follows: The filming of cylinder head fin vibration, which had resulted in breakage of cooling fins, revealed that this was a transient condition, excited by deformation of the cylinder head under gas forces present during combustion. This information greatly simplified the test of redesigns to cure the trouble. High speed photographs taken of two cutaway machine gun synchronizers showed a distinct difference in operation between two principal types under discussion, revealing that the action of one type was rapid and positive, whereas the other was sluggish and not at all positive in action. High speed motion pictures and multiple-flash still pictures of a transparent oil pump clearly showed the path of entrained air bubbles and the effect of clearance volume on recirculation of the air—information of interest to oil pump designers. Where strain gages and stroboscopic analysis had failed, high speed photography revealed that the flexibility of a valve gear, which previously was thought more than sufficiently rigid, but was a principal cause of valve gear malfunctioning encountered as take-off engine speeds were increased from 1850 to 2800 rpm.

Auxiliary Power Plants

By Blake Reynolds, Lawrance Engineering & Research Corp.

A YEAR ago there was merely a handful of planes which could boast auxiliary power. There are now several others which give proof of its ever-widening use. Long a proponent of auxiliary power plants, the Navy is



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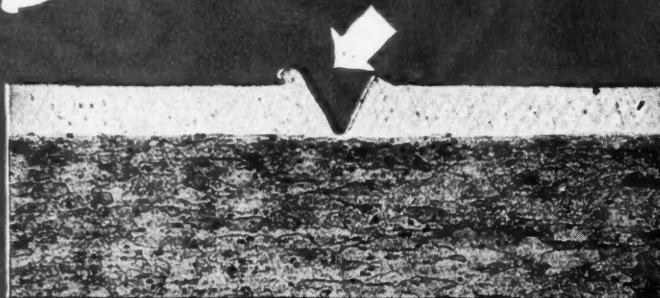
To meet the new conditions, Detrex has developed improved methods. Special machines and chemicals are applied to the fast, effective cleaning so necessary to war-winning production.

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Plane production was accelerated when Government Specification Agencies announced the above decision on what constitutes a "safe" or "unsafe" scratch in alclad aluminum sheet. Contractors were given a usable standard of quality. Though made some time ago, it is repeated here for the benefit of any workers in aluminum who may not be familiar with the ruling.

Data on which this decision was based have since been supplemented by considerable new data. All confirm and strengthen the original findings. Typical results of the newer tests are shown in the table at the right.

Even the deep scratch, penetrating to the base metal, had no effect upon tensile and yield strengths, and only a negligible effect upon the

elongation and fatigue strength.

It was again concluded, therefore, that scratches which do not penetrate through the alclad coating and into the core are not cause for rejection.

EFFECTS OF SCRATCHES ON TENSILE PROPERTIES*

Average Coating Thickness, In.	Average Depth of Scratch, In.	Average Depth of Scratch, Percent of Coating Thickness	Tensile Strength, Psi.	Yield Strength (Offset Equals 0.2 Percent), Psi.	Elongation in 2 In., Percent
0.0026	0	0	62 105	41 200	20.3
0.0025	0.00150	60	62 810	42 000	19.0
0.0028	0.00288	103	62 730	41 850	16.0

*All stresses computed on basis of full thickness of sheet.

Reprints of the paper, "Effect of Scratches on Fatigue Strength of Alclad Sheet", discussing these findings in detail, are available. For a copy, write ALUMINUM COMPANY OF AMERICA, 2110 Gulf Building, Pittsburgh, Pennsylvania.

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again demonstrating its confidence in their reliability, as it did some four years ago by installing two units as the sole source of electric power in the flying boats. Even the Army's installation of auxiliary power in its larger bombers is marking a new trend, since previous extensive usage has been limited to flying boats where the need for auxiliary power is more apparent. The main engines must be reliably started, the comfort of the crew must be observed by providing heat, light, and cooking facilities, and finally the all-important radio must be kept in operation. The use of auxiliary power in land planes is based primarily on the

need for ground power at unequipped air bases and on the high output requirements during landings when the main engines are throttled down below the minimum operating speed of the generators.

There are rising tendencies which point to the auxiliary power plant as the sole source of electric power in large aircraft. For one thing, the rear sections of the main engines and space behind them in the airplane installation have become a complicated maze of pipes, pads, wires, and accessories which seriously hampers maintenance and impairs reliability. The use of auxiliaries as the sole source of power

will materially alleviate this condition, will drastically simplify the design of main-engine rear sections, will eliminate a considerable weight of heavy wiring from the airplane, and in addition, will permit the construction of lighter generators as a result of removing them from the severe vibration encountered at the rear of the main engines.

Aircraft Service in Combat Areas

By G. R. Sanborn,
Service Engineer, Boeing Aircraft Co.

THIS paper deals with the duties and qualifications of the aircraft factory representative in the field. Due to the fact that considerable design information is required of the field representative, it is believed desirable that he have considerable background in engineering. Since many maintenance questions encountered are of a mechanical nature, it will also be necessary to choose a man having a background in maintenance work. To find a man with all these qualifications is extremely difficult. As a result, it is believed that the best policy to follow is that of choosing a good engineer thoroughly familiar with the design problems, operation of the aircraft and the theory of operation of all the various systems making up the aircraft. This man could be made senior representative in charge of a group of possibly three to five men. These five men should consist of a structural engineer, possibly other design engineers and maintenance mechanics. By choosing service representatives from the engineering division as well as the maintenance division, considerable advantage can be gained for future design work.

Experience with the Use of Magnesium in Aircraft

By J. C. Mathes,
The Dow Chemical Co.

IN REGARD to the question of supply, the speaker revealed that there is now an abundance of magnesium ingot, and magnesium ingot will continue to be abundant unless unknown factors in the war strategy change the situation materially. The fabricating facilities are now running at full capacity, but new facilities are being provided that should at least triple the amount of sheet available and should increase the availability of extrusions in all forms by from five to ten times. These new facilities are now coming in and should be completed shortly after January, 1944. Die casting capacity is being expanded and there should be no shortage here. There seems to be adequate sand casting facilities except for a few of the very intricate and large engine and wheel castings, and this condition is also being corrected.

Information was presented on the choice of the various DOWMETAL alloys in the form of castings, extrusions, forgings, and sheets; surface treat-



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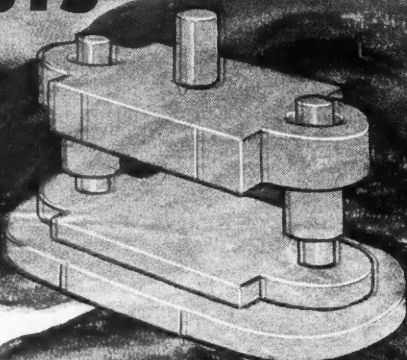
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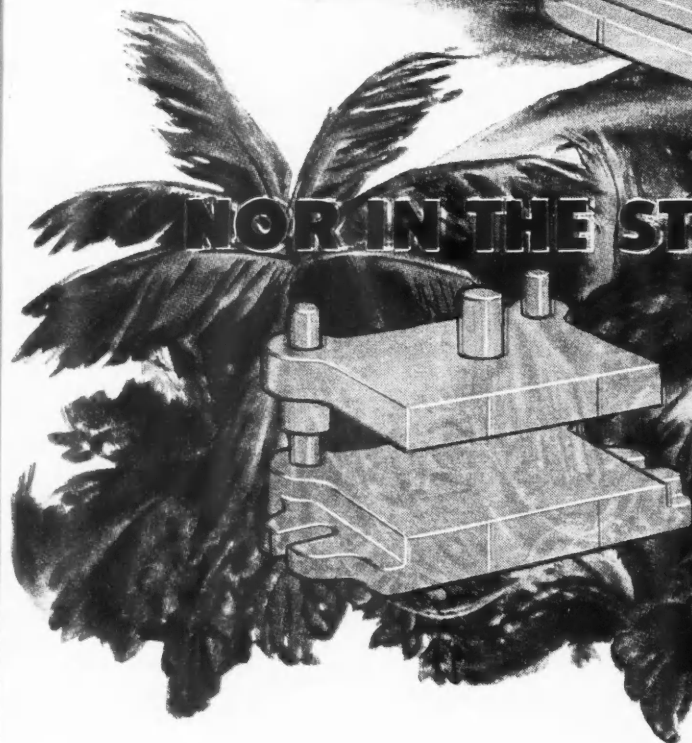
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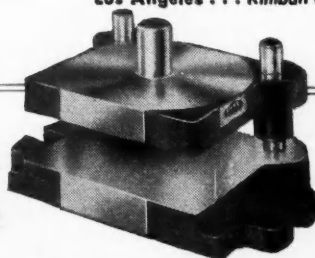
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ments and painting; stress corrosion; joining by riveting, spot welding, arc welding; service experience; the effect of gunfire; and the use of magnesium in constructing primary structures.

Comparison of Hydraulic and Electrical Accessory Systems in Aircraft

By W. C. Trautman, Bendix Aviation Ltd., and R. E. Middleton, Aircraft Accessories Corp.

TABLES 1 and 2 show comparative weights for a 1000 psi hydraulic system and a 28-volt electrical acces-

sory system on a medium-sized twin-engine attack bomber which has been in production for some time. Components included are two main landing gears, one nose wheel gear, bomb doors, and flaps. In the case of the hydraulic system the accumulator weight has been included; in the case of the electrical system the weight of the storage battery has not been included.

The weight advantage of hydraulic accessories becomes greater as the horsepower increases. This indicates that the greatest field of usefulness for the hydraulic system lies in high power applications such as are likely to be en-

countered in the larger airplanes of the future.

Table 1—Weight of Typical Hydraulic System for Medium Twin-Engined Bomber

Unit	No. Req. per Plane	Wt. per Plane (lb.)
Main Landing Gear Cylinder	2	23.40
Nose Wheel Cyl.	1	3.15
Bomb Door Cylinder Forward	2	14.60
Bomb Door Cylinder Aft	1	7.08
Flap Motor	1	4.25
Pesco Pump	2	7.80
Regulator	1	2.74
Accumulator	1	13.59
Reservoir	1	31.91
Filter	1	2.08
Bomb Door Selector Valve	1	1.35
Landing Gear Selector Valve	1	2.02
Flap Selector Valve ..	1	1.20
Relief Valve	1	1.00
Relief Valve (Thermal)	2	0.25
Misc. Fittings & Line	—	3.50
Clamps	—	40.19
Lines and Fittings....	—	171.11

Table 2—Weight of Typical Electrical System for Medium Twin-Engined Bombers

Unit	No. Req. per Plane	Wt. per Plane (lb.)
Generator	2	52.00
Main Landing Gear Motor	2	32.50
Nos. Landing Gear Motor	2	31.00
Bomb Door Motor....	1	24.00
Wing Flap Motor....	1	18.80
Main L. G. Screw Jack	2	3.76
Nose L. G. Screw Jack	1	2.10
Bomb Door Motor Screw Jack	1	4.00
Reversible Generator Relay	2	5.00
Voltage Regulator ...	2	5.20
Toggle Switch	7	0.56
Main Nose Motor Relay	3	4.20
Bomb Door Relay....	1	4.28
Wing Flap Relay	1	2.58
Switches, Junction Boxes, Circuit Breakers, Wiring etc.	—	34.46
Total Weight ..	—	224.44

Use of Generalized Coordinates in Flutter Analysis

By Samuel J. Loring, Chance Vought Aircraft Division, United Aircraft Corp.

PART 1 of this paper is an application to a particular problem in flutter of the method presented by the author in his paper "Outline of a General Approach to the Flutter Problem." Calculations are described for a cantilever wing which was flutter tested at the NACA Laboratories (Technical Report 685—1940) and the test results are compared with calculated results. The method of generalized coordinates in this case proved a convenient way of determining the role that the second bending mode played in the flutter of the model. Because of the generality of the method, it can be used for determining the effect of many factors (wing taper, higher vibration modes,



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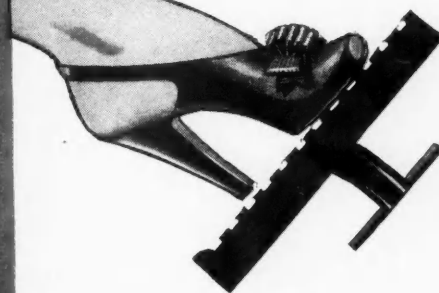
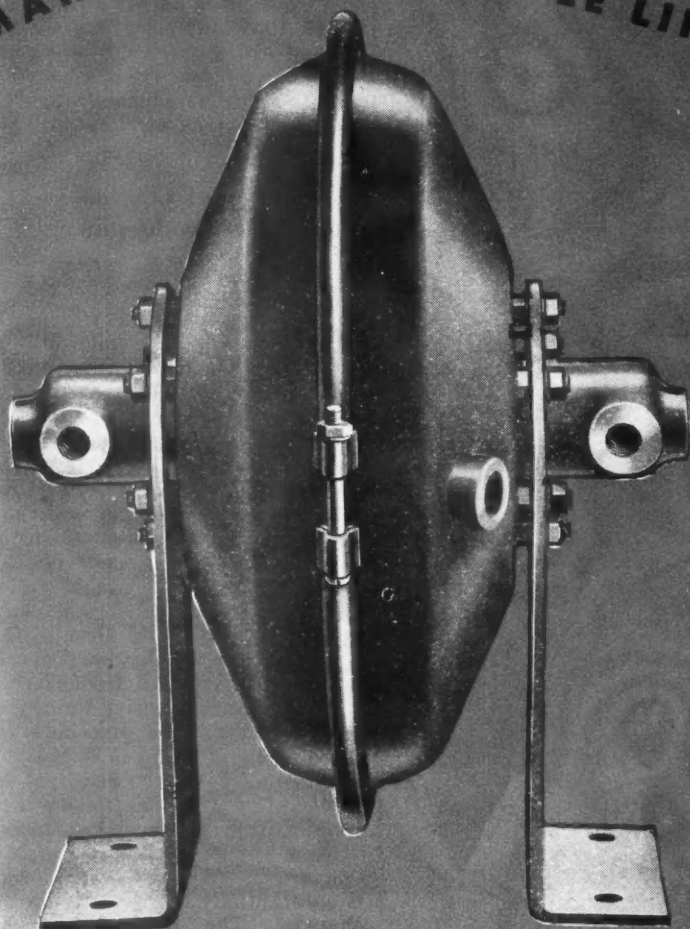
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The Vacdraulic Booster does not have to be built into the structure of a truck or bus, but at any time can easily be installed at a convenient point in the hydraulic sys-

tem, with a simple connection to the intake manifold.

This ease of installation particularly adapts it for the replacement of worn or obsolete booster equipment.

While the Empire plants are fully engaged in war production, Vacdraulic Brake Power Boosters are available for new installations or replacements within the limits of W.P.B. regulations.

Engineering data and full information on the new operating principle of the Vacdraulic Booster will be furnished on request. Correspondence is invited from Distributors who are interested in franchise arrangements covering exclusive territories.

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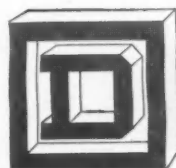
A REAL PROBLEM IN "OVERHEAD"

A six-and-a-half-million-dollar factory was being constructed—in which diesel engines for submarines were to be built. This plant called for an unusually large system of electrical power distribution. Normally, it would have been an overhead system—but such an installation was impossible because overhead clearance was needed for cranes and hoists.

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curved weight or stiffness axis, sweep forward, concentrated weights, etc.) that are difficult to allow for when using less general methods.

Part 2 presents a method for treating flutter with many degrees of freedom involving torsion, bending and flap deflection of one or more airfoil surfaces having aerodynamically balanced flaps, such as an airplane tail.

Scheduling of Changes in Aircraft Production

By H. S. Martin,
Consolidated Vultee Aircraft Corp.

CONSOLIDATED Vultee segregates changes into the following groups: Safety, Military Necessity, Production Improvement, and Miscellaneous. Safety and Military Necessity changes are called Master changes and are scheduled and controlled by a Master Scheduling Department, which reports to the Division Manager, a division being a separate and complete unit manufacturing one or more types of airplanes. Production and Miscellaneous changes are scheduled and controlled by a Change Control Group, which is a part of the Production Department, which is a part of a Division.

The principal reason for the difference in control and procedure for the two groups of changes is that Master changes affect all the principal departments of a division, the Service, and usually involve financial consideration. This is not generally true of the second group. When it is, the procedure is substantially the same as for Master changes. The objection to having either Engineering or Production control Master changes is that there is some basis for believing that engineering will make changes regardless of the effect on production, while Production will be reluctant to make even necessary changes. On the other hand, Production can usually be relied upon to make production improvement changes as soon as it is practicable to do so. Consequently, it is felt that if control and scheduling of Master changes is in charge of an individual or group responsible only to the Division Manager that the requirements of all concerned will receive proper consideration.

Servicing Military Aircraft in Overseas Theaters

By Clyde R. Paton and Wm. C. Gould,
Allison Div., General Motors Corp.

ONE of the outstanding conclusions reached as a result of overseas field service observations is that everything possible must be done in the design and engineering of aircraft to insure ease of service and maximum durability under the most primitive field conditions. Even though minimum weight is paramount, especially in the case of fighter aircraft, some weight increase even with fighters, and more so with bombers, is justified if it results



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it easier, more rapid servicing in the field or contributes to greater durability of engines, such as is obtained with effective dust protective equipment.

It appears particularly necessary that aircraft be designed so that they can be readily broken down into units, each complete in itself, and of such size as to be readily handled on standard transport vehicles and so that a minimum of time is required to remove any given unit and replace it with a new or overhauled assembly. The increased percentage time in the air makes up many times over for the slight increase in weight and decreased bomb load which can be carried. Total weight of

bombs delivered per month or per year is what is really important, not the weight of bombs per trip.

Frequently trouble due to pipes rubbing together and causing leaks is reported, since ground crews rarely check for this installation difficulty, and careful inspection rarely fails to reveal one or more pipes rubbing.

Greater attention should be given to power plant installations from the service time standpoint. It takes much too long to change an engine in any of the current installations. Power plant installations must be designed to withstand any amount of humidity and any amount of dirt. Dirt protection

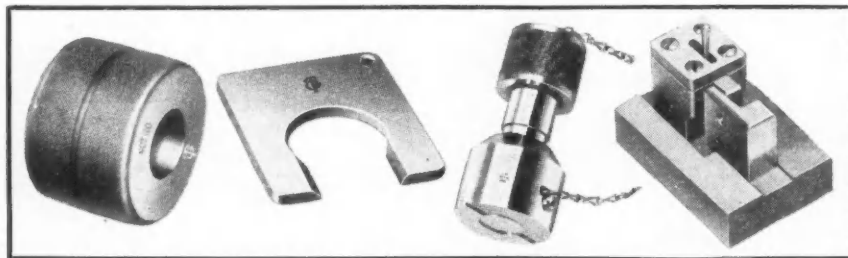
while aircraft are on the ground has been especially neglected. Carburetor air cleaner equipment should be full automatic in action, for pilots are not sufficiently conscious of its importance or interested in overall life of engines to be depended upon for satisfactory manual operation.

Despite the humidity factor, electrical equipment gives far less trouble in service than hydraulic equipment. The authors have never talked to a crew chief who would not prefer everything electrically to hydraulically operated. Hydraulic leaks are said to be common and difficult to correct in the field.

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Radiographic Inspection Of Light Alloy Castings

(Continued from page 40)

about the cause of the defect such as calling a cavity a gas cavity or a shrinkage cavity. This information is of interest to him because he desires to improve his foundry methods by eliminating such discontinuities.

The inspector acting on behalf of the customer is more interested in the strength of the casting than he is the causes of defects. Whereas causes of defect have a bearing on mechanical importance, nevertheless, if the inspector can learn the association of certain mechanical weaknesses in their relation to appearances on a radiograph, the cause of the defect still remains immaterial to him. It is, in fact, desirable to avoid casual deductions because they are, at times uncertain and confusing. The manner of classing defects, based on shape, size, position and distribution is more useful to the inspector.

It is of inestimable value to the inspector to have absolute coordination with structures, so that static tests may be performed on defective castings needing further investigation, whereafter standards may be set up based on stress tests, and which in turn aid greatly as a guide to future interpretation.

There are two important phases of a production inspection X-ray laboratory, one is "speed" the other "quality." In order that films may proceed through X-ray examination while the above phases remain present factors, radiographic techniques must be standardized and operators' maneuvers kept at a minimum. In the radiographic examination of aircraft castings it is not sufficient to think in terms of generalities. Precision can and must be attained even under mass production conditions and I have found that reducing exposure factor variables, which consist of time of exposure, milliamperage, focus-film distance and kilovoltage, to variation of kilovoltage alone greatly assists in high speed X-ray examination of aircraft castings.

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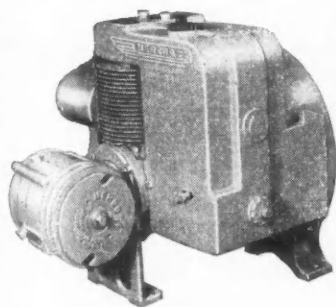
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On October 30, 1943, Kiekhaefer Corporation was presented with the coveted Army-Navy "E." It is a symbol of excellence in war production—recognition of a vital, important contribution to the Nation. The Kiekhaefer Corporation is proud of this accomplishment, and proud of the workers who gave their wholehearted, patriotic co-operation to make it possible.

We accept the honor with humble pride, realizing that we have only endeavored to do our part in back-

ing up the men at the front. But this is more than a war of guns and ammunition. It is also a war of equipment and materials, and America will win because she produces the best and most equipment for the best fighters in the world.

To the workers of the Kiekhaefer Corporation, this award is more than a symbol of achievement, it is an inspiration to put forth even greater effort in the future, to win, as quickly as possible, a just and lasting peace.



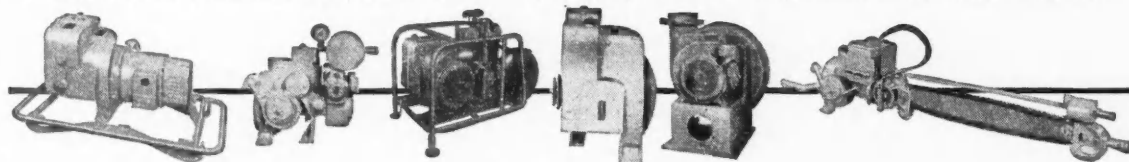
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GENERAL ELECTRIC

The Tire Crisis

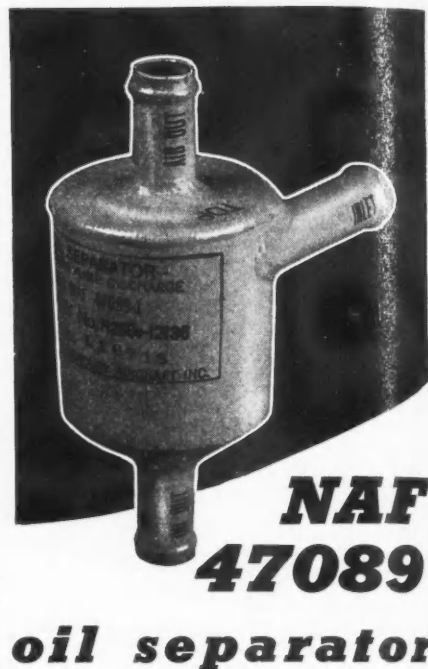
(Continued from page 17)

crease used or recapped passenger car tires by 28 per cent to 829,650 for November. Some of this increased demand for used tires is expected to come from commercial motor vehicles operated exclusively by medical or dental laboratories, or for the delivery of medical supplies, drugs, laundry, dry cleaning (apparel only) or essential foods to homes. Beginning Nov. 1, such vehicles were eligible to receive used passenger and truck tires of sizes smaller than 7.50-20 to replace tires which are no longer serviceable.

An adequate supply of synthetic rubber is assured for 1944, but how fast tire production can be increased is rather problematical at this time as much depends on the success in getting civilian tire machinery in operation. A \$70,000,000 plant expansion has been approved by the War Production Board and although much plant space is being converted back to tire production, several difficult reconversion problems confront tire manufacturers. When the manufacturer of passenger car tires for civilian use was discontinued in January of 1942, plants and equipment were converted to making war materiel. During the conversion period a heavy migration of skilled tire workers from the rubber industry to war plants took place and a large number were young men of draft age who had little claim at that time to draft deferment on the basis of their experience or essentiality in a war industry. Now Akron, the center of the tire industry and also of a number of war plants, has one of the most acute labor shortages in the country. Women can be used to some extent in manufacturing light tires, but they lack the necessary strength for the heavy work involved with large truck tires.

Then there is the "production experience" period that is necessary to get acquainted with new material. Physical properties of synthetic rubber are different than those of natural rubber, so much so that more man-hours and machine-hours are necessary to process the former. Tire manufacturers estimate that synthetic rubber tires require 15 to 20 per cent more labor and machinery than the same number of natural rubber tires of the same size.

The Fourth Progress Report of the Rubber Director states that synthetic rubber (Buna S) will be standard in production for all passenger car tires and truck and bus tires of the smaller sizes; also except for certain over-the-road bus and truck tires, varying combinations of synthetic rubber and from 10 to 30 per cent crude rubber will be used in 10-ply 7.00 tires and in all mud and snow and standard highway 7.50 to 10.00 tires. Due primarily to the shortage of rayon tire cord no synthetic rubber is being used in most sizes of highway truck and bus tires operated at high speeds and under



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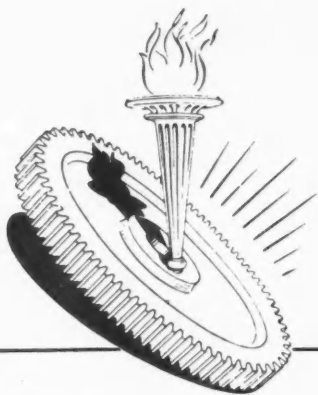
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Summary of the Automobile Tire Situation

(In millions of tires)

	Passenger Car Tires		
	1941	1943*	1944*
Demand	53.50	25.00	40.00
Supply	53.50	23.00	30.00
Stock (end of year)	11.00†	5.25x	(deficit 10.00)

	Truck Tires		
	1941	1943*	1944*
Demand	11.10	6.20	7.50
Supply	11.10	5.40	4.80
Stock (end of year)	5.00†	0.87x	(deficit 2.70)

*—Estimated

†—All new tires

x—All kinds, including emergency tires

heavy loads, nor in truck and bus tires over 10.50 in size, and mud and snow tires 18.00 and larger. Synthetic rubber tires in their present state of development are not the equal of prewar natural rubber tires, but their mileage can be increased by maintaining the recommended air pressure and avoiding high speed driving and overloading. Camelback for retreading truck tires is being made of synthetic rubber and for recapping other types of tires about 40 per cent of synthetic rubber is used with reclaimed rubber.

It will be recalled that when this country entered 1942 engaged in a global war, the tire industry had just completed the biggest year of tire shipments in its history. In 1941 approximately 53,500,000 passenger car tires

were shipped — 19,400,000 to vehicle manufacturers for new passenger cars and light trucks and 34,100,000 into the replacement market. During that year 11,100,000 truck tires were shipped—5,300,000 for new trucks and buses, and 5,800,000 into the replacement market. The result was a substantial inventory of 16 million passenger car and truck new tires at the beginning of 1942.

Another situation of 1940 and 1941 is also worth recalling at this time in light of the present tire developments and the dwindling stock of new automobiles so urgently needed to maintain the home-front economy. During those years certain Federal officials and labor leaders demanded that the automobile industry stop manufacturing passenger cars, claiming they were unessential to defense. These same critics had neither definite plans to offer the industry nor any defense equipment orders that would have permitted conversion of the automobile plants on a large scale basis. Knowing that stoppage of passenger car production would result in idle factories and widespread unemployment, the automobile companies built millions of cars and gradually took on more and more Government defense contracts as fast as they were offered to them. That decision has proved most fortunate for this country, because without those many millions of cars and tires during the past two years, the national economy

would have been imperiled to a dangerous degree, far beyond the effect caused by the critical tire situation existing in motor transportation today.

Propeller of Metal And Hard Rubber

A new type of airplane propeller now being built has a core of metal and a fairing of hard rubber into which bubbles of gas have been blown. Over the hard sponge rubber is a shell of rubber and neoprene, polished and lacquered. In addition to the neoprene chemical rubber, made by du Pont, which goes into this shell, neoprene cement and a neoprene binder are used.

The polished surface of the new propellers cuts down drag and wind resistance. The propellers are said to hold up under rain and sleet, cinders, sand and gravel, in temperatures that range from minus 70 degrees to 140 degrees, Fahrenheit.

Heinkel 111 Bomber

(Continued from page 25)

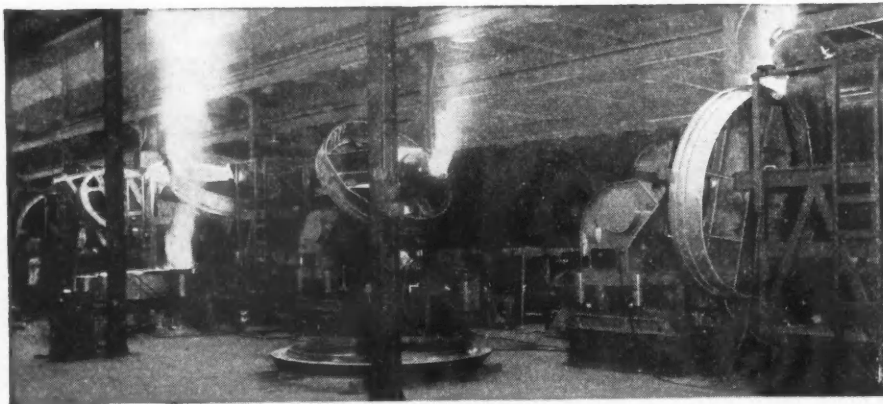
their field of view. (This sight is coupled to the bomb sight.)

In the designing of the prototype the possibility of using an alternative or a more powerful type of engine was kept in mind. For this reason the original He 111 was "over-dimensioned"; neither the structural strength nor the load capacity was fully utilized with the BMW VI engines originally available. But subsequently the DB 600 high-altitude engine was fitted and later the injection engines DB 601 and Ju 211. The additional power of these later engines enabled the load weight to be doubled and the maximum speed to be increased by approximately 62 mph.

Experience during the present war has led to further modifications. Thus, the internal bomb bays have been replaced by an additional protected fuel tank, increasing the range and enabling larger bombs to be carried, for the external suspension is capable of dealing with the heaviest of German bombs, while the drop in speed associated with external bombs is said to be negligible.

The defensive armament has been increased and heavy armor plating installed at various points. Aerodynamic qualities have been improved, while variable pitch propellers and retractable radiators are named as among other new devices incorporated of late.

Since the Heinkel 111 first appeared in 1933 more than 15 versions have been built, in some cases only with slight differences. They have been designated by letters, followed by index numbers 1 to 6, which indicate the types of wireless installation. The He 111H and P versions are equipped with different engines, as mentioned above, the former being powered by two Jumo 211 engines and the latter by two Mercedes-Benz DB-601 engines.



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